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WASTEPLAN IMPLEMENTATION IN MICHIGAN: THE IMPACT OF TRAINING WORKSHOPS ON PERCEPTIONS OF DIFFUSION VARIABLES AND SYSTEM USE

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WASTEPLAN IMPLEMENTATION IN MICHIGAN: THE IMPACT OF TRAINING WORKSHOPS ON PERCEPTIONS OF DIFFUSION VARIABLES AND SYSTEM USE

By

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ABSTRACT

WASTEPLAN IMPLEMENTATION IN MICHIGAN: THE IMPACT OF TRAINING WORKSHOPS ON PERCEPTIONS OF DIFFUSION VARIABLES AND SYSTEM USE

By

Gary Steven Meyer

This thesis addresses the implementation of WastePlan, IBM-PC solid waste management decision support software, within the State of Michigan by examining the impact of training workshops on specific diffusion variables and system use. A self-administered written questionnaire was utilized to obtain data from individual adopters. Mean difference scores were used to determine the extent to which adopters who participated in a workshop differed from those who had not, in their perceptions of diffusion variables and system use. Correlation coefficients were used to identify those diffusion variables most closely associated with system use. Results indicate little difference between groups in perceptions of diffusion variables or system use. An individual's perceived need for WastePlan was most closely associated with system use for both groups followed by relative advantage suggesting that use depends on a recognized need for WastePlan and the perception that it provides a superior means of solid waste management analysis.

To my parents

Who showed me the freedom in complete dedication.

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Chapter I: Introduction

A. WastePlan Development and Distribution

The need for solid waste management planning within the State of Michigan is greater now than at any time in the past. This is due in part to the Michigan Solid Waste Management Act, PA 641 of 1978, which, as amended, requires each county to prepare a 20-year solid waste management plan including mandatory five-year updates evaluating the feasibility of recycling, composting, and waste-to-energy technologies, and addressing roles for reduction and reuse. Officials within cities, townships, villages, municipalities, regional planning commissions, and educators (including extension specialists) throughout Michigan have taken an interest in solid waste management planning to ensure that their "community" meets the overall objectives of the State Solid Waste Management Policy. Prior to the development of WastePlan, however, solid waste management planners and decision-makers within the State of Michigan had been devoid of any tool capable of aiding integrated solid waste management planning efforts.

WastePlan is IBM-PC compatible decision support system software specifically designed for integrated solid waste management planning. As such, policy makers can address a wide variety of waste management strategies and their interrelationships including: source reduction, recycling, composting, resource recovery, and landfilling. WastePlan utilizes detailed modules to define waste streams, generation characteristics, collection systems, and facility types. Detailed reports provide information about the entire waste system and enable users to identify strategies that provide cost-effective solutions to specific solid waste management problems. The extensive Default Data Set allows users to incorporate generic data derived from detailed waste management studies when site-specific data is not available. As a planning tool, WastePlan can be used to help generate original solid waste management plans, confirm consultant reports, and negotiate and contract for services. In sum, WastePlan represents one of the most comprehensive computer models dealing with integrated solid waste management in existence today. (See also, CSWS Computer Model: MUNI 904, 1990; Integrated Waste Management Systems, 1989; PRIDE, 1990; RECYCLE, 1984; Second Opinion, 1989; & WastePlan, 1990.)

Tellus Institute (Tellus) began WastePlan development in 1988 with a $10,000 grant from the Office of Technology

Assessment. The Michigan Public Service Commission (PSC) contributed an additional $50,000 toward development of the software in that same year, and with the assistance of an advisory committee (including representatives from Michigan Solid Waste Management Planning Authorities, state and local government, and the private sector) helped Tellus identify specific characteristics that would be incorporated into the model. The result, WastePlan (v89-8), was a software model capable of analyzing the full range of waste management options.

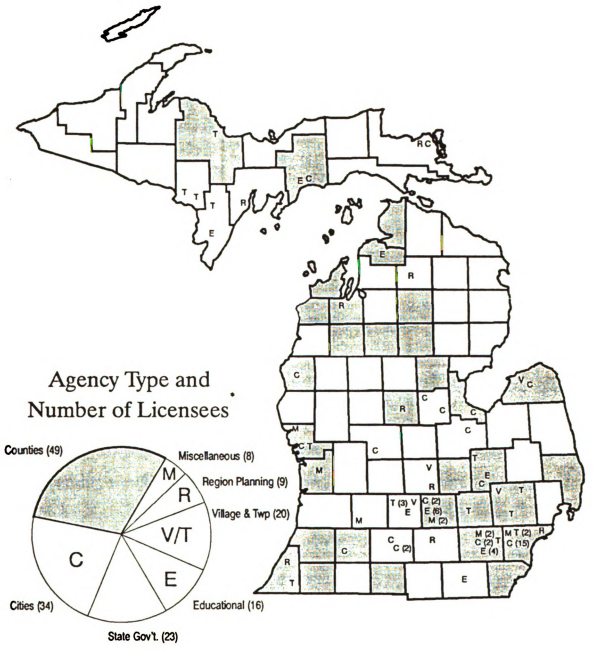
By October, 1990, 109 copies of the WastePlan software had been disseminated under Michigan's licensing agreement with Tellus, free-of-charge, to solid waste management planners throughout the State of Michigan. Subsequently a survey questionnaire was mailed to each user. Survey results revealed limited WastePlan use. Thirty-three percent of the respondents had not spent any time with WastePlan, while another 60 percent had spent less than 10 total hours familiarizing themselves with it.

A second phase of the WastePlan project began in August, 1990, when the United States Environmental Protection Agency provided $50,000 for an 18-month study to be carried out by the Department of Resource Development, Michigan State University (MSU). The MSU WastePlan staff

was to intensively disseminate, demonstrate, and evaluate WastePlan. Three pilot communities were selected to field test WastePlan, and a system support network was established that included hands-on training workshops, a telephone hotline, a WastePlan special interest group on the Michigan Department of Commerce electronic mail and bulletin board system, and a monthly newsletter. The Michigan Department of Commerce provided a like amount to secure a contract with Tellus for WastePlan updates, training, and technical support. In February, 1991, Tellus released an updated version of the WastePlan software (v90-6) to the State of Michigan. Although similar in design, it is conceptually easier to understand and utilize. As of July 1991, the State of Michigan had 159 licensees. Figure 1 illustrates the distribution of WastePlan software in Michigan, by location and organizational type (Meyer, Sandberg, & Stanton, 1991).

B. Problem Statement

Although substantial resources have been invested in the development and distribution of WastePlan, relatively little is known about implementation, that is, the degree to which the system (v90-6) is or is not currently being utilized and why. This research specifically addresses the issue of implementation by focusing on the impact that



The total number of licensees equals 159. State government agency licensees are not depicted on the map. Educational means copies licensed to universities for classroom use. Numbers of licensees are indicated in parentheses, both in the key and on the map.

Figure 1. Michigan WastePlan Distribution

training workshops have on the use of WastePlan.

Users of decision support systems often need more than the accompanying documentation (user manual) to utilize new software (Ketelaar, 1987). Training workshops enable individuals to gain hands-on experience in a structured setting, thus avoiding the frustrations often encountered in learning a new system. Furthermore, workshops provide an excellent forum for users to exchange information informally (Ketelaar, 1987) and receive individual feedback on system problems.

Two three-day training workshops were held as part of the total network support system established within the second phase of the WastePlan project. Approximately 20 individuals participated in each workshop. Each training workshop began with an orientation to the WastePlan model including basic keystroke manipulations, file maintenance techniques, and an overview of its capabilities and limitations. After initial familiarization, participants gained hands-on experience by analyzing a variety of story problems and case studies covering topics that included: recycling, composting, landfilling, resource recovery, county and regional facilities, and seasonal waste generation.

Although this research seeks to determine the impact of training workshops on system use, it is the user's perception of diffusion variables (Figure 2) that ultimately account for use. That is, training workshops themselves do not directly lead to increased system use, but rather influence specific variables related to use. Through training workshops, users may, for example, learn about specific system features that serve to reduce system complexity and thus lead to higher levels of use. Innovation diffusion research thus provides a framework for analysis. It has largely focused on the relationship between numerous independent variables, thought to enhance or inhibit innovation diffusion, and some dependent variable measuring adoption or implementation.

Diffusion Variables

Innovation Attributes	Individual Attributes
Compatibility	Competence
Relative advantage	Need
Complexity	
Trialability	Organizational Attributes
Observability	
Communicability	Organizational commitment
	Management support
	Need (within target area)
	Participation

Figure 2. Diffusion Variables.

C. Research Questions

The following three research questions are addressed within this study:

1. Is there a significant difference in the perception of diffusion attributes between individuals who participated in a workshop and individuals who did not participate in a workshop?

2. Is there a significant difference in system use between individuals who participated in a workshop and individuals who did not participate in a workshop?

3. How is each diffusion attribute correlated with system use both for individuals who participated in a workshop and for those who did not? Is there a significant difference between these correlation coefficients?

D. Delimitations

Delimitations relate specifically to the generalizability of research findings beyond this study.

Application of findings may be limited by the following factors:

1. Subject characteristics. Data collection comes solely from individuals who live in the State of Michigan and work within the public sector.

2. Innovation specificity. Results are based exclusively on WastePlan implementation, the only innovation considered within this research.

Due to the recent development of WastePlan, relatively few individuals have access to the software.[1] The 159 licensees within the State of Michigan (see Figure 1, p. 5) represent the largest single group within the United States to whom WastePlan has been distributed and thus will provide the most extensive data available at this time. That each individual works within the public sector is attributable to the fact that, contractually, WastePlan may only be distributed within the State of Michigan to individuals in the public sector.

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[1] To date, WastePlan has been distributed in Delaware, Illinois, Maine, Michigan, New York State and New York City, Ventura County, California, and Vermont.

Research findings are based on experiences related to a single innovation primarily because of this researcher's extensive work with WastePlan as Project Coordinator and limited practical experience with other, similar innovations. It should also be noted that WastePlan is a specific type of decision support system, one that deals exclusively with integrated solid waste management planning.

Given these delimitations, readers are cautioned against applying research results derived herein to other groups of individuals or other types of decision support systems. Individuals within the private sector, or public sector outside the State of Michigan may have their own unique characteristics that would not allow generalizability. Decision support systems not specifically related to integrated solid waste management planning may be too dissimilar to WastePlan to enable results to be generalized beyond this study.

E. Limitations

Limitations relate specifically to the internal validity of the study. One limitation of this research concerns the fact that most Michigan WastePlan licensees have only had access to the current WastePlan software for eight months (at the time of the survey), and some as few as

three months. Innovations such as the WastePlan decision support system sometimes take years before they are fully implemented or routinized within the adopting organization. This may be especially true of WastePlan because solid waste management planners need time to collect site-specific information and furthermore may only utilize WastePlan when a specific need for analysis is present. WastePlan licensees, furthermore, may have obtained the software simply because it is available free-of-charge, believing there may be a need sometime in the future.

A second limitation of this research concerns the categorization of individuals who have participated in WastePlan training workshops. Since both training workshops were very similar in design, no differentiation was made in assessing the perceptions of individuals who participated in one or both workshops. In all, 38 individuals participated in the workshops. Twenty individuals participated in a single workshop while nine participated in both workshops.

F. Definitions

The distinction between innovation adoption and implementation has often been blurred in past studies dealing with innovation diffusion (Tornatzky & Klein, 1982). A definition for each is thus provided below, along with a

definition for decision support systems (the type of innovation under consideration within this research), as they will be used within this study.

Adoption. Innovation adoption will be used within this study to represent the decision by an individual (or other decision-making unit) to make use of an innovation. The adoption decision (Figure 3, p. 13) is typically preceded by information-gathering, conceptualizing, and planning, all a part of the initiation stage within the total innovation process (Rogers, 1983, p. 363). Within this study, the adoption decision will be considered to have been made by, or at the time the individual requested the software. It should be noted, however, that all WastePlan licensees may not have actually made the adoption decision. That is, in some cases a supervisor may have requested the software and passed it on to the actual implementor, or the software may have been left behind by a previous employee within the organization. Additionally, the adoption decision typically entails a financial outlay. With WastePlan, however, this is not the case; the software is distributed free-of-charge to all individuals within public sector organizations that request it. Some costs, however, may be incurred such as upgrading existing computer equipment or reallocating employee (implementor) time.

Stages in the innovation process	Major activities at each stage
I. Initiation:	All of the information-gathering, conceptualizing, and planning for the adoption of an innovation, leading up to adoption decision
1. Agenda setting	General organizational problems, which may create a perceived need for an innovation, are defined; the environment is searched for potential value to the organization
2. Matching	A problem from the organization's agenda is considered together with an innovation, and the fit between them is planned and designed
- - - - - - - - - -The decision to adopt- - - - - - - - - -	
II. Implementation:	All of the events, actions and decisions involved in putting an innovation into use
3. Redefining/ Restructuring	(1) The innovation is modified and invented to fit the situation of the particular organization and its perceived problem, and (2) organizational structures directly relevant to the innovation are altered to accommodate the innovation
4. Clarifying	The relationship between the innovation and organization is defined more clearly as the innovation is put into full and regular use
5. Routinizing	The innovation eventually loses its separate identity and becomes an element in the organization's ongoing activities

Figure 3. Stages in the Innovation Process in Organizations. From Rogers, 1983, page 363.

Implementation. Innovation implementation will be used within this study to describe the actual use of an innovation by an individual (or other decision-making unit) (Rogers, 1983, p. 20). As noted in Figure 3, implementation encompasses a series of events, actions, and decisions involved in putting the innovation into use. Tornatzky and Klein (1982) furthermore note the importance of post-adoption variability in implementation. That is, the degree to which the innovation has been implemented will vary among users.

Decision support system. A decision support system (DSS) is quite simply a system that generates information used to support a decision (Seilheimer, 1988). Floyd, Turner III, and Davis (1989, p. 482) note that a DSS, "functions to bring data, models, software interfaces, and the user together into an effective decision-making system." A DSS allows decision-makers to retrieve, manipulate, and analyze information as well as develop and test various solutions so that they may answer not only the "what-is" but also the "what-if" questions of decision-making (Mykytyn,Jr., 1988; Seilheimer, 1988; Simmons & Poulos, 1988). Finally, a DSS should be differentiated from an optimization model, the latter providing a single "best" answer to a particular problem.

G. Significance of the Study

WastePlan, a decision support system dealing with integrated solid waste management, has been developed at substantial cost to enable planners and decision-makers to consider the cost-effectiveness of various solid waste management alternatives. Preliminary survey results indicated very little utilization of the model. With a substantially revised WastePlan system and a support network in place, this follow-up study addresses the issue of system implementation by focusing specifically on the impact of training workshops on diffusion variables and ultimately on system use.

Research results will help assess the viability of educational training workshops as a method of support for implementing decision support systems. By analyzing attribute perceptions and use patterns of licensees who have attended training workshops vis a vis attribute perceptions and use patterns of licensees who have not, the viability of continued training may be addressed along with the possibility of designing future workshops to address those attributes found to be most closely associated with system use. Specifically, results may be used by Tellus Institute (WastePlan developers) as they search for more efficient ways to implement WastePlan within states that have

purchased the system, by the US EPA which is considering WastePlan for national distribution, and by the MSU WastePlan staff in their continuing efforts to implement WastePlan within the State of Michigan.

Chapter II: Review of the Literature

A. Innovation Research: An Historical Overview

Empirical research on the diffusion of innovations began approximately fifty years ago, although scholarly interest in the topic began around 1900. Rogers (1983, p. 11) defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" and notes that diffusion is the spread of an innovation through communication channels to the members of a social system, over time. Early research focused on individual decision makers, such as a farmer deciding to adopt hybrid corn seed or a doctor deciding to adopt a new drug (Van de Ven & Rogers, 1988). The focus of innovation research then began to shift from the individual to the organization in the late 1960's. This shift marked an important turning point in the history of innovation research, as symbolized by Zaltman, Duncan, and Holbek's Innovations and Organizations (1973), which laid the foundation for studying innovation in an organizational context. The dependent variable typically associated with such studies also began to shift from adoption (defined as

the decision to use an innovation) to implementation (actually putting the innovation to use) (Van de Ven & Rogers, 1988).

Numerous studies of innovation diffusion within organizations have been conducted since the 1960's. Early studies utilized variance research in which the covariances among a set of variables were analyzed but not their time-order. More recent studies of organizational innovation, however, have looked at the process of innovation within organizations and thus utilized process research which permits the time-ordered sequence of events to be determined (Rogers, 1988).

Innovation research has emerged over the years "as possibly the most fashionable of social science areas" (Downs & Mohr, 1976, P. 700). In spite of, or perhaps because of its popularity, several criticisms have been levied against this body of research.

Pro-innovation bias within diffusion research reflects the belief that innovations are good and should be adopted and readily diffused among all members of a social system without re-invention, discontinuance, or rejection (Rogers, 1983). Nelkin (1973) refers to this phenomenon as "technological fix," an overdependence on technological

innovations to solve complex social problems. The pro-innovation bias has led researchers to focus almost exclusively on successful innovation projects at the expense of less successful or failed projects. Thus, although a tremendous amount of information is known about readily adopted innovations, little information is available to explain the reasons for re-invention, discontinuance, or complete rejection of an innovation. One way to overcome the pro-innovation bias is to study the diffusion of innovations as they occur, rather than after they have been widely diffused (Rogers, 1983). This would encourage an examination of a much broader array of innovations and make explicit the fact that rejection, discontinuance, and re-invention do frequently occur.

Another criticism against innovation research is the extreme variance among its findings. Downs and Mohr (1976, p. 700) note, "factors found to be important for innovation in one study are found to be considerably less important, not important at all, or even inversely important in another study." In essence, empirical research has consisted of various projects, scattered over numerous disciplines, motivated by different considerations, employing a very heterogeneous selection of independent variables (Mohr, 1969). Because of this, numerous researchers have found it difficult to make aggregate statements about innovation

behavior (Damanpour, 1988; Downs & Mohr, 1976; Lucas, 1982).

One explanation for the instability of the research relates to the way in which the dependent variable "innovativeness" or "successful diffusion" has been measured. Some researchers have deemed an innovation successful upon adoption, while others have argued that success is not achieved until the innovation has been routinized within the adopting system. Success has been operationalized in numerous ways, including: the extent to which the innovation is used; user satisfaction; the extent to which the innovation meets its original goals and specifications; and the contribution the innovation makes to the organization (Gray, 1981; Lucas 1989).

A second explanation for the inconsistent findings is the interaction between independent variables (Downs & Mohr, 1976). The impact of one independent variable on successful innovation, thus may depend to a large extent on one or more other independent variables. Rogers (1983, p. 130) suggests that "the real nature of diffusion is certainly a cobweb of interrelationships among numerous conceptual variables."

A related issue with respect to independent variables is definition congruence. Several variables have taken on different meanings for different researchers. Relative

advantage, for example, has come to represent numerous miscellaneous attributes including economic advantage (profitability) as well as social advantage (Tornatzky & Klein, 1982).

A third explanation for the disparate findings in innovation research stems from its dependence upon recall data from respondents (Rogers, 1983). Respondents have typically been asked to step back in time and recall past innovation experiences. Their ability to do so varies, however, depending on one's ability to accurately recall past events. Relatedly, innovations, by their very nature, diffuse over time. Researchers, however, have relied upon a "snapshot," a one-time survey to measure innovation. Research results may be more harmonious if innovation was studied over time, thus capturing a "moving picture" as opposed to a simple snapshot.

A final explanation for the instability in research findings stems from the failure to account for the entire diffusion process. Early studies focused primarily on the adoption/non-adoption dichotomy. This narrow view, however, did not take into consideration different events that occurred during implementation, or in other words, after explicit commitment had been made to utilize an innovation (Tornatzky & Klein, 1982). As Downs and Mohr (1976, p. 709)

point out, "operationalizing innovation by the extent of implementation comes closer to capturing the variations in behavior that we really want to explain." The importance of specifying the relationship between an independent variable and a particular stage of innovation is crucial because independent variables have been shown to vary with different stages of the innovation diffusion process.

Despite its shortcomings, innovation research provides a suitable framework for this study. The emphasis within this study is not on the diffusion of one particular innovation (WastePlan) as it relates to the diffusion of a broad spectrum of innovations, but rather on the impact of training workshops on independent diffusion variables and ultimately on system utilization.

B. Diffusion Variables: Identification and Discussion

Independent variables identified in past studies relating to the diffusion of innovations may be broken down into the following three categories: innovation attributes; individual attributes; and organizational attributes (including extraorganizational attributes). Specific attributes considered within this study were selected based on usage in past research studies, relevance to WastePlan, the innovation under consideration within this study, and

the expert opinion of academic professionals experienced in the field of innovation research. Those variables selected for inclusion within this study are identified and reviewed below.

1. Innovation Attributes

Innovation attributes relate to the characteristics of the innovation itself. Individual perceptions of these characteristics formed the basis for early innovation studies as researchers realized that the way in which individuals perceived these attributes will have a definite impact on adoption and implementation.

Compatibility. As defined by Rogers and Shoemaker (1971) compatibility may refer to compatibility with the values of potential adopters or may represent congruence with the existing practices of the adopters. Although sometimes difficult to determine which aspect of compatibility is being measured in the literature, the compatibility of an innovation is thought to be positively related to the adoption and implementation of the innovation (Tornatzky & Klein, 1982). An innovation which departs substantially from tradition is less likely to be readily accepted than one which "represents a variation, perhaps, on a well-known theme" (Fliegel & Kivlin, 1966, p. 246) due to

the comparatively large number of changes required for use (Chatman, 1985). Within this study, compatibility serves as a measure of WastePlan's congruence with the existing practices of users.

Several studies lend support to the compatibility-diffusion proposition. Perry and Danziger (1980) found compatibility relevant in their study of the adoptability of computer applications within American local governments as did Chatman (1985) in the diffusion of job information. One exception came from Fliegel and Kivlin (1966), who found no support for compatibility among farmers adopting modern farm practices. In their meta-analysis, Tornatzky and Klein (1982) found compatibility to be positively related to an innovation's adoption, but cautioned that this conclusion is limited by the fact that "some of the studies measured practical compatibility, some value compatibility, and some a combination of the two" (Tornatzky & Klein, 1982, p. 134).

Relative Advantage. Defined by Rogers and Shoemaker (1971, p.138) as "the degree to which an innovation is perceived as being better than the idea it supersedes," relative advantage is so broad, that it may be expressed in terms of economic profitability or measured in several other ways.

Although sometimes unclear as to which aspect of relative advantage is being considered, most researchers support the notion that an innovation is more likely to be adopted and implemented the greater its relative advantage. Leonard-Barton and Kraus (1985, p. 108) note that "an innovation must offer an obvious advantage over whatever it replaces, or potential users will have little incentive to use it." Tornatzky and Klein (1982), recognizing the difficulties inherent in analyzing various aspects of relative advantage, limit their meta-analysis to studies actually measuring the profitability of the innovation (probably the most frequently considered characteristic of relative advantage). In short, they found relative advantage to be statistically significant and positively related to the adoption of innovations. Relative advantage is used within this study to measure the overall extent to which WastePlan offers an advantage vis a vis other tools used in solid waste management planning. Profitability is not isolated because savings associated with a decision software model such as WastePlan are often difficult to quantify.

Complexity. Defined by Rogers and Shoemaker (1971, p. 154) as "the degree to which an innovation is perceived as relatively difficult to understand and use," complexity is thought to be negatively related to innovation adoption and

implementation. Without exception, complexity was negatively related to innovation diffusion in each of the relevant studies reviewed herein (Fliegel & Kivlin, 1966; Lucas, 1976; Lucas, 1981; Perry & Kraemer, 1978). Tornatzky and Klein (1982) found similarly strong results where all but seven of twenty-one studies reviewed, found a negative relationship between the complexity of an innovation and its adoption and implementation. Within this study, complexity is used to measure the difficulty perceived in understanding and utilizing the WastePlan software.

Trialability. Trialability is "the degree to which an innovation may be experimented with on a limited basis" (Rogers & Shoemaker, 1971, p. 155). A trialable innovation may be a low-risk, relatively small, easily reversible innovation as opposed to an innovation that can be tried out on a small scale first, commonly referred to as a divisible innovation. Those innovations which possess a relatively high degree of trialability are thought to be adopted and implemented more often and more quickly than less trialable innovations. Trialability is used within this study to measure the extent to which the innovation can be experimented with on a limited basis before deciding whether or not to use it on a regular basis.

Few studies have examined this attribute of innovations. Tornatzky and Klein (1982) did, however, review eight studies mentioning trialability. Five of the eight provided statistically favorable results, however no firm conclusion was drawn because the studies could not be easily summarized.

Observability. Observability may be defined as the "degree to which the results of an innovation are visible to others" (Rogers & Shoemaker, 1971, p. 155). This characteristic may take on added significance when the innovation is diffused in risk-sensitive markets. Oren and Schwartz (1988, p. 274) note, in such an environment "learning involves finding out about how a product performs rather than just learning of the product's availability." Independent of any particular market, however, the more visible the results of an innovation, the more likely the innovation will be quickly adopted and implemented. Although this proposition is logically sound, little empirical evidence is available to support it. Tornatzky and Klein (1982) found little evidence in their meta-analysis, where only two of seven studies provided any direct correlational measure of the observability-adoption relationship.

Communicability. As defined by Rothman (1974), communicability is very similar and obviously related to the characteristic of observability as defined by Rogers and Shoemaker (1971). Whereas observability is the degree to which the results of an innovation are visible to others, communicability may be thought of as the degree to which aspects of an innovation may be conveyed to others. Leonard-Barton (1988, p. 608) expands this definition to include "the degree to which a technology's operating principles (know-how) and underlying scientific principles (know-why) can be communicated to people other than its developers." The communicability of an innovation is considered to be positively related to the adoption and implementation of the innovation. Communicability is used within this study to measure the degree to which WastePlan's operating principles (know-how) can be communicated to others.

To date, few studies have examined the innovation characteristic of communicability. In her research covering fourteen case studies of organizational innovation implementation, Leonard-Barton (1988, p. 618) found transferability (a characteristic comprised of communicability and preparedness (defined as the extent to which a technology has shown proof of feasibility in a laboratory or in an operational setting)) to be a "necessary

if not sufficient condition for the implementation of a new technology." Perry and Kraemer (1978), on the other hand, did not find communicability to be significant in their analysis of computer application innovation among local governments, however their measure only considered one very technical aspect of communicability, the extent of documentation within the application manual. Tornatzky and Klein (1982) found similarly poor results, with only three of the thirteen references showing statistical significance directly relevant to the communicability-adoption relationship.

2. Individual Attributes

Although innovation research, especially early on, focused on specific attributes of innovations, researchers have now recognized the need to examine specific characteristics of individuals as well. Individuals, after all, are the adopters and/or implementors of innovations.

Competence. Broadly, competence may be conceived as the degree to which an individual possesses the means (non-monetary) necessary to adopt and implement an innovation. Roberts-Gray and Gray (1983, p. 220) note the importance of individual capability to perform with the innovation. They represent individual capability as "knowledge, skill, and

experience" associated with implementation of an innovation, and indicate that capability is representative of what can be implemented versus what will be implemented. Perry and Danziger (1980) share a similar view of competence, especially as related to the individual's skill level and experience. Several researchers have found competence to be associated with adoptability including: Blau (1963), Lu, Hsieh, and Pan (1989), and Perry and Danziger (1980).

Need. The need for an innovation includes both "objective and subjective assessments. . .to be met by utilization of the innovation" (Perry & Danziger, 1980, p. 465). Researchers propose that an individual will be more likely to adopt and implement an innovation, the greater the perceived need for the innovation. Robey and Zeller (1978), in their study of the adoption and implementation of information systems, operationalized need as perceived urgency and importance and found the need-adoptability relationship to be statistically significant. Need is used within this study to measure the degree to which individuals believe WastePlan is a useful aid in their solid waste management planning.

3. Organizational Attributes

Primarily through their work in examining attributes of individuals as related to innovation diffusion, researchers realized that individuals do not adopt or implement an innovation in a vacuum, but rather often do so within an organizational setting. Kanter (1988, p. 205) notes, "undeniably, innovation stems from individual talent and creativity. . . but whether or not individual skills are activated, exercised, supported, and channelled. . .is a function of the organizational and interorganizational context."

Participation. Numerous researchers have observed that the involvement of targeted users in the selection and design of innovations, especially those related to computer applications, increases the likelihood of acceptance (Ives & Olson, 1984; Johnson & Rice, 1987; Locke & Schweiger, 1979). Participative decision making, in fact, has been hypothesized to be an effective implementation tactic (Nutt, 1986; Robey & Farrow, 1982). Participation may increase user acceptance by leading to system ownership (Robey & Farrow, 1982), decreasing user resistance to change (Lucas, 1974), and committing users to the system (Markus, 1983). Although WastePlan adopters did not have an opportunity to participate in the design of WastePlan, some were more

involved in the decision to obtain the model than others. Participation is used within this study to measure the degree to which individuals were involved in the decision to obtain WastePlan.

Organizational commitment. The commitment or non-commitment of resources by an organization to an innovation has been shown to enhance or inhibit successful implementation (Mohr, 1969; Nilakanta & Scamell, 1990). Gray (1981, p. 22) states, "at the organizational level, it is possible to facilitate the adoption of an innovation by providing resources and services which would not ordinarily be available to the organization." Studies, furthermore, indicate that successful adoption and implementation requires a sustained level of investment in addition to those committed initially (Leonard-Barton & Kraus, 1985). Relatedly, several researchers, studying the implementation of computer applications in local governments, found the availability of external funding in the form of federal financial assistance to be positively associated with innovation adoptability (Danziger & Dutton, 1977; Perry & Danziger, 1980; Perry & Kraemer, 1978). Organizational commitment is used within this study to measure the commitment of resources, such as time and computers, necessary for users to utilize the system.

Management Support. Management support, as related to innovation diffusion, may be conceived of as the degree to which a manager (in some cases upper management) assumes responsibility for the innovation's adoption and implementation. Support may be provided by allocating or reallocating resources, both material and political or by serving as an opinion leader and "providing task and socio-emotional information about the innovation and appropriate adoption behaviors" (Johnson & Rice, 1987, p. 38; Roberts, 1977). Leonard-Barton and Kraus (1985) indicate that to be effective, opinion leaders should have "safety" credibility (manager is enough like subordinate for opinions to be trusted) and "technical" credibility (manager knows what s/he is talking about). Management support is used within this study to measure the degree to which one's manager supports (nonmonetary) WastePlan efforts.

It is proposed that the stronger the management support for an innovation, the greater the likelihood that it will be adopted and implemented successfully. Empirical support for this proposition is strong. The management support-diffusion relationship has been shown to be relevant in numerous studies examining a variety of innovations diffusing in multiple settings (Johnson & Rice, 1987; Leonard-Barton, 1981; Leonard-Barton & Kraus, 1985; Lucas, 1976; Lucas, 1981; Nilakanta & Scamell, 1990).

Extraorganizational attributes define an organization's relationship to its environment and are important to consider since innovation is, in many respects, an interorganizational process (Tornatzky et al., 1983). Kanter (1988, p. 204) suggests "the more dependent an organization is on others," the more likely it is that the organization "will be shaped or constrained in its internal innovation by those portions of the environment which dominate it."

Need. Within this study, this extraorganizational attribute relates to the perceived need for solid waste management planning within the target area (city, county, region, etc.) the individual is employed. Greater external need, stimulated for example by a landfill closure, should lead to increased system utilization.

C. Summary

Past research results utilizing various independent variables are mixed. As noted in the literature review, variables such as relative advantage, complexity, competence, and management support have been more consistently and significantly correlated with a dependent measure of innovativeness or adoption and implementation than other variables such as compatibility and

observability. Furthermore, variables such as trialability and communicability have not been tested frequently enough to ascertain their potential contribution to the innovation process. Nonetheless, of the numerous diffusion variables utilized to date, each variable reviewed above was selected for inclusion within this study based upon its perceived relevance to the particular innovation under consideration, determined through an extensive review of the literature and consultation with diffusion experts. Each independent diffusion variable and its expected correlation (direction) with WastePlan implementation is noted in Figure 4 below. Past research indicates that, overall, each variable has been positively associated with implementation except complexity which has been negatively associated with implementation.

Diffusion variables	Expected correlation with WastePlan implementation
Innovation attributes	
Compatibility	+
Relative advantage	+
Complexity	-
Trialability	+
Observability	+
Communicability	+
Individual attributes	
Competence	+
Need	+
Organizational attributes	
Participation	+
Organizational commitment	+
Management support	+
Need	+

Figure 4. Expected Correlation of Diffusion Variables with WastePlan Implementation.

Chapter III: Methods

A. Study Population

Subjects selected for participation within this study include all WastePlan licensees (See Figure 1, p. 5) except individuals not directly involved in solid waste management planning and individuals who have not had the system for at least three months. Licensees not directly involved in solid waste management planning consist primarily of educators who obtained WastePlan through their public-sector status. These individuals were excluded because their rationale for use, and subsequent pattern of use are thought to be significantly different from those involved directly in solid waste management planning. Whereas educators will, in most cases, use the tool for educational purposes, that is, as an introduction to solid waste management, solid waste management planners will use the tool "in the field" for actual solid waste management evaluation and decision-making.

Individuals who had not obtained the system at least three months prior to this study were also excluded due to

the time involved in learning to use a decision support system such as WastePlan. Use patterns of individuals who recently obtained the system were thought to be too dissimilar to those who have had the model for several months.

The 140 individuals selected for participation within this study include licensees within the State of Michigan all of whom are employed within the public sector. Contractual stipulations with Tellus prohibit the distribution of WastePlan within the private sector. Of the 140 potential respondents, 29 individuals had attended one or both workshops while 111 individuals had not attended either. Table 1 classifies licensees by their affiliation within a specific level of government: state; county; city; township; village or as part of a regional planning commission which transcends governmental boundaries.

Table 1. Study Population: Affiliation and Number.

Public sector affiliation	Number
Governmental level	
County	51
City	33
State	20
Township	16
Village	4
Regional Planning Commission	8
Miscellaneous	8
Total	140

B. Instrumentation

To ascertain the information needed for this study, a two-part written questionnaire was developed (Appendix A). The first part of the questionnaire was designed to measure user perceptions of the independent diffusion variables (reviewed in Chapter II), and the second part was designed to measure the dependent variable, system use or degree of implementation.

To measure user perceptions of the independent variables, respondents were presented 24 statements (randomly distributed throughout the questionnaire) along with a five-point likert-type scale ranging from strongly disagree to strongly agree, and asked to circle the one response which most closely matched their feelings[2]. Each of the 12 variables under consideration was represented by two statements, one stated affirmatively, the other stated negatively. Statements were presented in this manner to facilitate a reliability check. If both statements were measuring the same concept, an inverse relationship would exist between the two statements.

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[2] The design for part one of the questionnaire was modeled after Oshins (1991) in his work with the adoption of composting programs.

The dependent variable, system use, was measured in part two of the questionnaire using four questions, each designed to measure a separate aspect of system use. This approach facilitated the incorporation of the various ways in which system use has been measured previously into a single composite indicator representing system utilization. A five point likert-type scale was presented with each question and respondents were asked to mark the one response that best reflected their use of the model (Appendix A).

The survey instrument (questionnaire) was developed through the following sequence of events. Each variable selected for inclusion within the study was operationalized based on past research studies and specificity to the WastePlan model, and randomly ordered within the instrument. The first draft was then submitted to academic professionals for review. After initial revisions, the instrument was pretested among 11 individuals outside the State of Michigan familiar with WastePlan. This group of individuals consisted of solid waste management professionals representative of the individuals within the State of Michigan who would later make up the actual study respondents. Second revisions were made to the instrument based on seven returned responses and again submitted to

academic professionals for review[3].

Two important considerations in the development of the survey instrument were reliability and validity. Reliability refers to the stability of the measurement process (Loether & McTavish, 1974), while validity refers to the extent to which variables are operationalized to reflect the "real meaning" of the concept under consideration (Babbie, 1983). To enhance reliability within the instrument, each statement was carefully worded to minimize respondent interpretation and multi-item scales were incorporated where possible. To assure validity, measures established in past research studies were utilized where feasible, and variable operationalization was discussed at great length with experts familiar with diffusion research.

C. Data Collection

After final revisions, the survey questionnaire along with an introductory cover letter (Appendix B) was mailed to the 140 Michigan WastePlan licensees selected for participation within this study. To facilitate response rate, a stamped, self-addressed envelope accompanied each survey. As an incentive, respondents were offered both the

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[3] Two additional pretest responses were received, however, only after final revisions had been made to the questionnaire.

Recycling Wheel and the Household Hazardous Waste Wheel (innovative tools that provide quick access to detailed and useful waste management information) for their participation in the survey. To facilitate confidentiality, respondents were asked not to include their name on the survey. Numbers corresponding to the respondent's database record were placed on the backside of the return envelopes, however, so that responses from individuals who had participated in a workshop could be differentiated from those who had not, and so that the wheels could be sent to those individuals who returned the survey. After two weeks, a follow-up survey and cover letter (Appendix C) was mailed to respondents who had not yet returned the questionnaire. A stamped, self-addressed envelope was again provided with the survey to facilitate response. Those respondents who still had not returned the survey questionnaire were then phoned ten days later. Individuals were asked if they had received the questionnaire(s), whether or not they had any questions regarding its completion, and then urged to respond if at all possible. Overall response rates are presented in Table 2. The first half of Table 2 illustrates the response rate to each of the two surveys, and the second half of Table 2 illustrates the response rate categorized by whether or not the respondent participated in a workshop. In sum, 95 surveys were returned representing a 68 percent response rate. Fifteen unusable surveys were returned, however, and

Table 2. Survey Questionnaire Response Rates.

	Number sent	Number returned	Percent returned
Initial survey	140	35 (a)	
Follow-up survey	105	60 (b)	
Total number of surveys returned		95	68
Workshop respondents	29	27	93
Non-workshop respondents	111	53	48
Total number of usable surveys returned		80	
Total percent of usable surveys returned			57

(a) This total includes three unusable surveys.
(b) This total includes twelve unusable surveys.

subsequently excluded from analysis.[4] Of the 80 usable surveys, 27 were returned from individuals who had participated in a workshop (representing a 93 percent response rate) while 53 were returned from individuals who had not participated in a workshop (representing a 48 percent response rate).

D. Treatment of the Data

1. Variable Relationships

The functional relationship between training workshops and system use is depicted in Figure 5. It should first of all be noted that training workshops themselves probably do not directly impact system use, but rather influence user perceptions of innovation, individual, and organizational attributes which in turn impact system use. An arrow illustrates the impact of training workshops on user perceptions of the independent diffusion variables. Training workshops have no impact on the organizational attribute "participation" because this variable refers to the extent to which the individual participated in the decision to obtain the system, a decision made prior to the workshops. The impact of user perceptions of the diffusion

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[4] Completely blank surveys and surveys returned with a significant number of unanswered questions (more than half) were excluded from analysis.

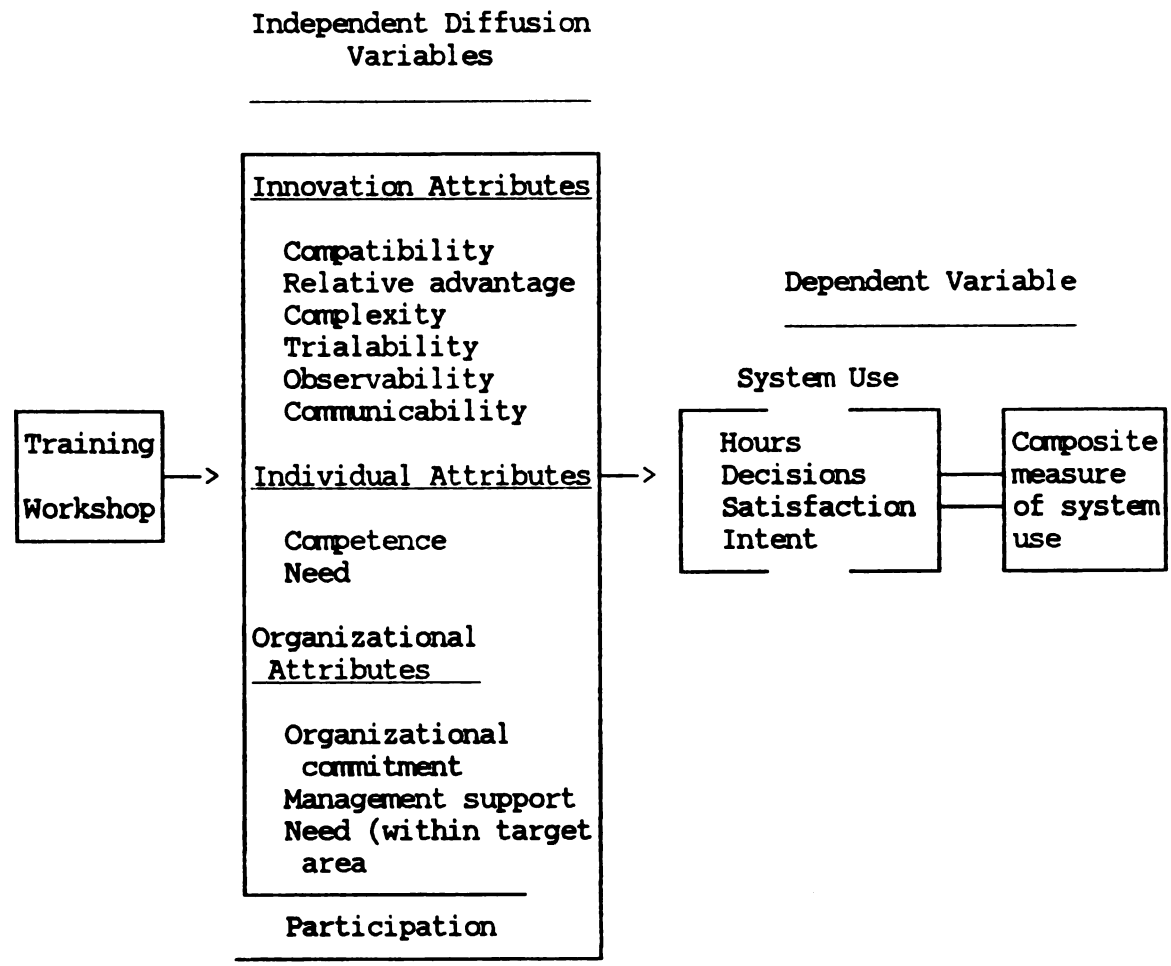

Figure 5. Functional Model.

variables on the dependent variable, system use, is also represented in Figure 5 by an arrow. The dependent variable, system use, is measured separately by: number of hours of system use per week; percent of decisions that incorporated WastePlan analysis; satisfaction with the system; and intent to use the system in the future. System use is ultimately measured utilizing a composite indicator consisting of the four separate measures.

2. Variable Coding

Each independent diffusion variable was operationalized twice in Part I of the survey questionnaire, once positively stated and once negatively stated, and measured on a five-point likert-type scale ranging from strongly disagree to strongly agree (Appendix A). Each statement was initially coded on a scale of (1) strongly disagree to (5) strongly agree. Scores for the negative statements were then reverse coded, combined with their complimentary positive statement, and averaged to obtain a single measure of each independent diffusion variable.[5]

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[5] In those few cases where respondents failed to answer a particular question, the mirror image question was used to complete the response. A respondent's score of 5, for example, for relative advantage stated positively would be applied as a 1 if the response for relative advantage stated negatively was missing. If the respondent failed to complete two corresponding questions, that is, the same attribute stated positively and negatively, the overall average for that question, determined by all other respondents, was used.

Each aspect of system use, the dependent variable within this study, was operationalized with a single question in Part II of the survey questionnaire and measured on a five-point scale (See Appendix A). Each question was coded 1 (low use) through 5 (high use) to obtain four separate measures of use and then combined and averaged to obtain one composite indicator of system use.[6]

3. Statistical Treatment

The impact of training workshops on diffusion variables and ultimately on system use is assessed through the three research questions presented in Chapter I (restated below). The statistical means by which each question is analyzed is presented below. In the following discussion, Group A refers to those individuals who have not participated in a workshop, while Group B refers to those individuals who have participated in a workshop.

Research Question 1. Is there a significant difference in the perception of diffusion attributes between individuals who participated in a workshop and individuals who did not participate in a workshop?

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[6] In those few cases where respondents failed to answer a particular question, the average of that respondent's answers for other questions also measuring system use was used.

Respondents were first categorized based on whether or not they participated in a training workshop (Group A and Group B). A t-test (test of mean scores) was then conducted between groups for each diffusion variable to determine if a statistically significant difference existed.

Research Question 2. Is there a significant difference in system use between individuals who participated in a workshop and individuals who did not participate in a workshop?

A t-test was conducted between Group A and Group B for each independent measure of use as well as the composite indicator which incorporates all independent measures. In all, five separate t-tests were used to determine whether or not a statistically significant difference existed in system use between the two groups.

Research Question 3. How is each diffusion attribute correlated with system use both for individuals who participated in a workshop and for those who did not? Is there a significant difference between these correlation coefficients?

This question was addressed first by determining the correlation coefficient (direction and strength) for both

groups between each independent diffusion variable and the composite measure of the dependent variable, system use. Correlation coefficients for each variable (and each group) were then transformed to Z-scores and Z-tests were calculated to ascertain whether correlation coefficients obtained for each group were statistically different from each other.

Chapter IV: Results and Discussion

This chapter presents and discusses results of data analysis associated with each research question proposed in Chapter III. Treatment of the independent diffusion variables and the dependent variable (system use), for purposes of data analysis, is, however, first presented below. As used previously, Group A refers to those respondents who did not participate in a workshop, while Group B refers to those respondents who did participate in a workshop.

A. Treatment of Independent Variables for Data Analysis

In Part I of the survey questionnaire, respondents were provided 24 statements (one stated positively and one stated negatively) representing the 12 independent diffusion variables under consideration. Each pair of statements was correlated to determine intra-statement reliability. Since one statement was presented positively and the other negatively, a strong inverse correlation would indicate reliability between statements. Results, presented in Figure 6, illustrate a significant inverse correlation

(significance level set at p <.05) between each pair of statements except those representing the variable compatibility, which had a small positive correlation.

Diffusion Variable	Correlation Coefficient	Significance Level (p)
Innovation attribute		
Compatibility	.0566	.309
Relative advantage	-.4124	.000 (*)
Complexity	-.5475	.000 (*)
Trialability	-.2147	.028 (*)
Observability	-.3844	.000 (*)
Communicability	-.7902	.000 (*)
Individual attribute		
Competence	-.5385	.000 (*)
Need	-.3217	.002 (*)
Organizational attribute		
Participation	-.6504	.000 (*)
Organizational commitment	-.6763	.000 (*)
Management support	-.6548	.000 (*)
Need	-.3452	.001 (*)

(*) indicates significance at p <.05

Figure 6. Independent Variable Intra-statement Reliability.

For each variable with intra-statement reliability, negative statements were reverse coded, added to corresponding positive statements, and averaged for use in later analysis.[7] For the variable compatibility, it was

[7] Since a negative correlation was expected between the independent diffusion variable, complexity, and the dependent variable, system use, the positive statement (statement 11, Part I of the survey), "WastePlan is easy to comprehend and utilize," was reverse coded.

determined that the two statements were not measuring the same component of compatibility (a validity issue) and thus separated for later analysis, with statement 6 "Use of WastePlan requires a great deal of personal and/or organizational change" representing compatibility with personal and organizational values, and statement 12 "WastePlan is very similar to other computer programs (not specifically waste management software) I have used previously" representing compatibility with other software used previously by the respondent. Statement 6 was reverse coded for use in later analysis.

B. Treatment of the Dependent Variable for Data Analysis

The dependent variable, system use or implementation, was measured in Part II of the survey questionnaire through four questions, each designed to incorporate a separate aspect of use: number of hours of system use per week; percent of decisions that incorporated WastePlan analysis; satisfaction with the system; and intent to use the system in the future. A composite scale of system use was developed by averaging each of the four questions after they were summed together. Intra-statement reliability, measured by Cronbach's Alpha, was sufficiently high at .6925 to warrant use of the composite in later analysis, and importantly, higher than the Alpha computed if any one of

the questions was deleted (Figure 7).

Component of Dependent Variable Measured	Alpha if Item Deleted
Use--hours of system use	.6492
Use--decisions made	.6673
Use--satisfaction	.5959
Use--future intent	.5629
Use--composite scale	.6925

Figure 7. Dependent Variable Intra-question Reliability.

C. Perceptions of Independent Diffusion Variables

To ascertain whether a significant difference existed in the perception of independent diffusion variables between respondents who participated in a workshop and respondents who did not (Research Question 1), a t-test (test of mean scores) was conducted between groups for each variable. Figure 8 lists the mean scores for each group along with the observed significance levels.[8] Overall, mean scores varied little, although scores for Group B were consistently higher (with the exception of communicability) than scores for

[8] Mean scores fall on a continuum from one to five corresponding to the scale used in the survey questionnaire, where one represented strongly disagree, two--disagree somewhat, three--neutral/undecided, four--agree somewhat, and five--strongly agree. A low mean score indicates the perception that WastePlan has little of that attribute, whereas a high mean score indicates the perception that WastePlan has a great deal of that attribute.

Diffusion Variable		Mean Score	Significance Level (p)
Innovation attribute			
Compatibility (with software)	(A)	3.0189	.179
	(B)	3.3333	
Compatibility (with values)	(A)	3.3019	.901
	(B)	3.3333	
Relative advantage	(A)	3.3585	.192
	(B)	3.5370	
Complexity	(A)	2.7830	.779
	(B)	2.8519	
Trialability	(A)	3.5849	.383
	(B)	3.7407	
Observability	(A)	3.4906	.035 (*)
	(B)	3.8333	
Communicability	(A)	3.1887	.852
	(B)	3.1481	
Individual attribute			
Competence	(A)	3.3396	.686
	(B)	3.4444	
Need	(A)	3.4245	.909
	(B)	3.4444	
Organizational attribute			
Participation	(A)	3.5755	.235
	(B)	3.9259	
Organizational commitment	(A)	3.0377	.541
	(B)	3.2037	
Management support	(A)	3.3396	.058
	(B)	3.8148	
Need	(A)	4.2547	.766
	(B)	4.2963	

Group(A) = Respondents who did not participate in a workshop
Group(B) = Respondents who did participate in a workshop
(*) indicates significance at $p < .05$

Figure 8. Mean Score Comparison for Diffusion Variables.

Group A. A significant difference between mean scores ($p < .05$) was noted only for the variable observability, indicating that the group of respondents who participated in a workshop perceived WastePlan as more observable (relative to those who did not), that is, WastePlan's usefulness was better understood by observing the results of analysis. Of the remaining independent diffusion variables, both groups of respondents rated the need for WastePlan analysis within their region of employment highest, and complexity lowest.

D. System Use

To ascertain whether a significant difference existed in WastePlan use (implementation) between the groups of respondents (Research Question 2), a t-test (test of mean scores) was conducted between groups for each of the four separate measures of use as well as the composite indicator. Mean scores for each group along with the observed significance levels are noted in Figure 9.[9] In each case, except decisions in which WastePlan analysis was utilized, mean scores were higher for the group of respondents who participated in a workshop as compared to the group of respondents who did not participate in a workshop. In no case, however, was the difference significant ($p < .05$).

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[9] Mean scores for each measure range from one, indicating little system use to five, indicating high system use.

Dependent Variable (system use)	Mean Score	Significance Level (p)
Aspect of use measured		
Use--hours of system use	(A) 1.5660 (B) 1.6667	.502
Use--decisions made	(A) 1.4151 (B) 1.2963	.439
Use--satisfaction	(A) 2.8113 (B) 2.9259	.667
Use--future intent	(A) 2.9057 (B) 3.1111	.481
Composite measure		
Use--composite scale	(A) 2.1745 (B) 2.2500	.641

Group(A) = Respondents who did not participate in a workshop
Group(B) = Respondents who did participate in a workshop

Figure 9. Mean Score Comparison for System Use.

While the composite indicator reveals an overall low level of WastePlan use, 2.1745 for Group A and 2.2500 for Group B, actual WastePlan use, as measured by hours of system use per week and percent of decisions incorporating WastePlan analysis, was significantly lower (below two) for each group. Average hours of WastePlan use per week for both groups was less than two hours. Additionally, significantly less than 25 percent of waste management decisions incorporated WastePlan analysis. The two components of use, measuring system satisfaction and intent of future use were higher for both groups, however, closely approximating or exceeding three, indicating intermediate levels.

E. Independent and Dependent Variable Correlations

1. Non-Workshop Respondents

Correlation coefficients and corresponding significance levels between the independent diffusion variables and the dependent variable system use for Group A, the group of respondents who did not participate in a workshop, are noted in Figure 10. Correlation coefficients were found to be positive for each attribute except complexity, corresponding precisely to the directions expected (see Figure 4; page

Diffusion Variable	Correlation Coefficient	Significance Level (p)
Innovation attribute		
Compatibility (with software)	.1728	.108
Compatibility (with values)	.2947	.016 (*)
Relative advantage	.6425	.000 (*)
Complexity	-.4205	.001 (*)
Trialability	.3687	.003 (*)
Observability	.5357	.000 (*)
Communicability	.4271	.001 (*)
Individual attribute		
Competence	.2085	.067
Need	.6970	.000 (*)
Organizational attribute		
Participation	.1875	.089
Organizational commitment	.3645	.004 (*)
Management support	.2458	.038 (*)
Need	.4512	.000 (*)

(*) indicates significance at p <.05

Figure 10. Diffusion Variable Correlations with Implementation (Non-Workshop Respondents).

36). Of the 13 diffusion variables,[10] all but three compatibility (with software), competence, and participation were significantly correlated ($p < .05$) with the dependent composite scale indicator, system use.

2. Workshop Respondents

Correlation coefficients and corresponding significance levels between the independent diffusion variables and the dependent variable system use for Group B, the group of respondents that did participate in a workshop, are noted in Figure 11. Correlation results for this group of respondents revealed a much different pattern than the one observed for non-workshop respondents. Whereas each correlation coefficient for the latter group was found in the direction expected, four correlation coefficients for the former group were found in the opposite direction; complexity had a positive correlation coefficient, while compatibility (with software), communicability, and competence all had negative correlation coefficients. Additionally, whereas ten of the correlation coefficients were significant ($p < .05$) for the group of respondents who did not participate in a workshop, only five correlation coefficients were significant ($p < .05$) for the group of

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[10] Increased from 12 when compatibility was divided into separate attributes.

Diffusion Variable	Correlation Coefficient	Significance Level (p)
Innovation attribute		
Compatibility (with software)	-.1591	.214
Compatibility (with values)	.1054	.300
Relative advantage	.5354	.002 (*)
Complexity	.2104	.146
Trialability	.2256	.129
Observability	.0645	.375
Communicability	-.1019	.306
Individual attribute		
Competence	-.1223	.272
Need	.6738	.000 (*)
Organizational attribute		
Participation	.3829	.024 (*)
Organizational commitment	.4521	.009 (*)
Management support	.0344	.432
Need	.4448	.010 (*)

(*) indicates significance at p <.05

Figure 11. Diffusion Variable Correlations with Implementation (Workshop Respondents).

respondents who did participate in a workshop. These included: relative advantage, individual need, participation, organizational commitment, and need within the region of employment. For both groups of respondents, the correlation coefficient was highest for the attribute individual need (Group A .6970 and Group B .6738).

Correlation coefficients for each group were transformed to Z-scores and then tested (Z-tests) to determine whether any statistically significant differences existed between the two groups. As noted in Figure 12, significant differences between correlation coefficients were found in three variables: complexity, observability, and communicability.

F. Discussion

1. Mean Scores (Independent Diffusion Variables)

With the exception of complexity, the mean score for each innovation attribute (both groups) ranged between three, a score indicating that respondents were "undecided" whether or not that attribute was associated with WastePlan, and four, a score indicating that respondents "agree(d) somewhat" that the attribute was associated with

Diffusion Variable	Z-Test Scores
Innovation attribute	
Compatibility (with software)	-1.33
Compatibility (with values)	-0.81
Relative advantage	-0.64
Complexity	2.09 (*)
Trialability	-0.64
Observability	-2.17 (*)
Communicability	-2.26 (*)
Individual attribute	
Competence	-1.33
Need	-0.16
Organizational attribute	
Participation	0.84
Organizational commitment	0.44
Management support	-0.89
Need	-0.04

(*) indicates statistically significant difference at p <.05

Figure 12. Z-test Summary.

Wasteplan[11]. Observability, the only innovation attribute in which a significant difference existed between group mean scores, received the highest rating among the respondents who had participated in a workshop. That this group of respondents rated observability highest, and significantly higher than the group of respondents who did not participate in a workshop, suggests that the workshop, through the numerous case studies and story problems reviewed, enabled participants to clearly observe WastePlan's usefulness through analysis of WastePlan results. The fact that six of the seven mean innovation attribute scores between groups were not significantly different indicates, however, that on the whole, workshops had little impact on participants' perception of diffusion variables typically associated with implementation or system use.

Mean scores for complexity were the lowest of the innovation attributes (non-workshop respondents 2.7830 and workshop respondents 2.8519). These scores indicate that respondents fell between "disagree somewhat" and "undecided" with respect to WastePlan's complexity level, somewhat surprising results considering the fact that many workshop participants noted, anecdotally, that the more they learned

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[11] Scores for each diffusion variable were measured on the following five-point scale: (1) strongly disagree (2) disagree somewhat (3) neutral/undecided (4) agree somewhat (5) strongly agree.

about WastePlan, the more complex it seemed to be. Respondents who did not participate in a workshop, either simply do not believe the system is very complex, or alternatively, may be overestimating their capabilities to utilize the tool. Evidence for the latter possibility is suggested by the intermediate score 3.0189 attributed to the variable compatibility (with software). That is, this group of respondents seems decisively undecided whether or not WastePlan is similar to other computer software they have used in the past, suggesting a superficial level of use; one in which the complexity of the tool may not have been uncovered. Extremely low use levels of WastePlan have been noted previously and will be discussed further later in this chapter.

Mean scores between groups for the individual attributes, competence and need, were not found to be significantly different from each other. Scores, in fact, were very similar ranging from a low of 3.3396 to a high of 3.4444. As was the case with scores for the majority of innovation attributes, these scores fell between the scale points "undecided" and "agree(d) somewhat." Thus, both groups of respondents believe they have some measure of need for WastePlan as individuals involved in waste management and also feel somewhat competent in their use of the tool. That no significant difference was found between scores,

however, suggests that the workshop had little influence on participants' perceptions of either variable. It was anticipated that participants would perceive an increased need for WastePlan through the numerous and distinctly varied case studies and story problems analyzed in the workshop. As participants were exposed to the many different types of waste management problems WastePlan is able to address, the perceived need for the system, to address one or more of these problems, was expected to increase (at least relative to individuals who had not been exposed to the myriad of problems which may be addressed). A similar effect was anticipated for the attribute competence, where increased use and practice with the tool through the workshops was expected to increase competence relative to those who did not participate. As was the case with complexity, however, the scores for competence may reflect a combination of workshop participants' realization that they have much to learn about the system before it can be utilized effectively, and also non-participants' overestimation of their competence level, stemming from insufficient experience with the tool.

Overall, mean scores for the organizational attributes were somewhat higher than those observed for either innovation or individual attributes. Except for organizational commitment, mean scores approached or

exceeded four, indicating that respondents "agree(d) somewhat" that these attributes are associated with WastePlan. Although not significant (at $p < .05$), differences in mean scores between groups of respondents for the attributes participation and management support, are noteworthy. While workshops had no impact on respondents' participation in the adoption process (and were not expected to), higher mean scores attributed to this attribute by workshop participants 3.9259 vis a vis non-workshop participants 3.5755, suggests that active participation in the adoption process may influence the decision to at least attend a workshop. This may be due to a greater up-front interest in the decision support system itself (in this case WastePlan), an increased feeling of ownership derived from participation within the adoption process itself (Robey & Farrow, 1982), decreased resistance to change (Lucas, 1974), or increased commitment (Markus, 1983).

A broad, yet non-significant range, was also noted for the variable management support where the mean score for workshop participants was 3.8148 as compared to 3.3396 for non-workshop participants. Although feasible that the workshop sufficiently interested and motivated participants to secure management support, it is perhaps more likely that increased support (for those who attended a workshop) existed prior to the workshop, and like participation in the

adoption process, may have been useful for encouraging individuals to participate in a workshop. Without management support, workshop participants may not have been able to secure the time or financial resources necessary for participation.

Mean scores for the organizational attribute need (for WastePlan analysis within the city, county, region, etc. within which waste management efforts are directed) were highest for both groups, exceeding mean scores for any other attribute including innovation and individual attributes. Mean scores exceeding four, workshop participants 4.2963 and non-workshop participants 4.2547, indicated that respondents fell between "agree somewhat" and "strongly agree" that there exists a need for WastePlan in the field. Given the similarity in scores, however, it does not appear as though the workshop had any significant influence on participants' perception of this variable. That is, the need for a tool such as WastePlan seems strong and clear to all respondents (engaged in solid waste management planning), and influenced little by examining the various capabilities and applications of the tool through a workshop.

2. Mean Scores (System Use)

Overall, mean scores between groups for individual aspects of system use as well as the composite indicator of system use were low and non-significant. Mean scores for each measure were so similar, in fact, that the widest range between group scores was .2054, a difference noted in the measure, "intent to use WastePlan in the future." The non-significant difference in mean scores between groups of respondents suggests that the workshops had little impact on participants' perceptions of diffusion variables typically associated with use; a result noted above in the non-significant difference in mean scores among 12 of the 13 diffusion variables (see Figure 8, p.54).

The first two measures of system use or implementation, (hours and decisions) accounted for actual system use. Mean scores for system use, measured by the number of hours of use per week, were quite low, only slightly exceeding 1.5 for both groups of respondents.[12] These scores indicate that, on average, respondents were utilizing the system only

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[12] Scores for this aspect of system use were measured on the following five-point scale:

(1) I do not use WastePlan
(2) Less than 2 hours per week
(3) Between 2 and 5 hours per week
(4) Between 5 and 10 hours per week
(5) More than 10 hours per week

about one hour per week; an insufficient amount of time for any meaningful analysis. In all likelihood, the majority of respondents were not using the system at all, however the few that were brought the average up, if only slightly.

Mean scores for system use, measured by the percent of waste management decisions that included WastePlan analysis, were the lowest of all aspects of use included in the composite indicator at 1.4151 for respondents who did not participate in a workshop and 1.2963 for respondents who did participate in a workshop.[13] These scores suggest that WastePlan analysis was included in very few waste management decisions. As may have been the case with hours of use per week, the majority of respondents did not include WastePlan analysis in any decision made, although the few that did brought the average up.

Mean scores for use, measured in terms of satisfaction (ranging from (1) not at all satisfied to (5) extremely satisfied), were slightly below three for both groups of respondents suggesting that an intermediate satisfaction

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[13] Scores for this measure of use were obtained through the following five-point scale:

(1) Zero
(2) Less than 25 percent
(3) Between 25 and 50 percent
(4) Between 50 and 75 percent
(5) More than 75 percent

level was perceived even though use was minimal. Similar mean scores (approximating three) were obtained for use, measured in terms of the likelihood that WastePlan would be routinely used in future waste management planning and analysis (ranging from (1) not at all likely to (5) extremely likely). These scores suggest an intermediate likelihood that WastePlan will be used in the future, even if it has been used relatively infrequently to this point.

Although use, as measured by hours of use per week and percent of decisions incorporating WastePlan analysis, at the time of the survey questionnaire was extremely low, measures of satisfaction and intent to use the system in the future were at an intermediate range. To interpret this finding, one must realize that the number of waste management decisions in which WastePlan may be incorporated are infrequent, often lagging slightly behind the time at which mandatory five-year updates are to be submitted. Actual use may, therefore, have been low, both in terms of hours used and decisions made, because updates were still approximately two years away for the majority of respondents.[14] Intermediate satisfaction levels and indications of intent to use WastePlan in the future may therefore suggest that this decision support system will be

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[14] Previous updates were due in 1988. If turned in late, succeeding updates would be due five years henceforth.

utilized more frequently as five-year updates approach their deadline.

3. Independent/Dependent Variable Correlations

Correlations between the independent diffusion variables and system use or implementation are discussed below. Each group of attributes (innovation, individual,and organizational) are discussed in turn, with a focus on trends within and between groups of respondents.

Correlation coefficients for the innovation attributes among the group of respondents who did not participate in a workshop were found in the direction expected based on past research, all positively correlated with system use except complexity. Additionally, each of the correlation coefficients was significant (at $p < .05$) except the correlation for the attribute compatibility (with software) (see Figure 10, p. 58). Of the innovation attributes, relative advantage had the strongest correlation with system use at .6425, revealing a strong association between respondents' perception of WastePlan as a superior tool for waste management planning and analysis and use of the system. That this variable was significant, and in fact, highly correlated with system use, is consistent with past research which has consistently found this innovation

attribute, more than any other, to be most closely associated with implementation (Tornatzky & Klein, 1982).

The pattern of correlation coefficients related to innovation attributes for the group of respondents who participated in a workshop was much different from the one observed for the group of individuals who did not (see Figure 11, p.60). Of the seven variables, only relative advantage had a significant correlation coefficient ($p < .05$). Moreover, three of the attributes had correlation coefficients in the opposite direction of that predicted by past research; compatibility (with software) and communicability both had negative correlation coefficients, while complexity had a positive coefficient.

That relative advantage had the strongest and only significant correlation again evidences the strength of this attribute in its association with implementation. The negative correlation associated with complexity, while not significant, was still somewhat substantial at .2104 and thus merits discussion. Past research has, almost without exception, found a negative correlation between complexity and implementation (Fliegel & Kivlin, 1966; Lucas, 1976; Lucas, 1981; Perry & Kraemer, 1978; Tornatzky & Klein, 1982), which seems reasonable since the more complex the innovation, that is, the more difficult to understand and

utilize, the less likely one may be to use it. One possible explanation for the anomaly found here is that workshop participants came to view WastePlan as complex, through the numerous case studies and story problems solved, and perhaps necessarily so in order to be useful in waste management planning and analysis which is itself very complex. Workshop participants may believe that a tool less complex and sophisticated would not have the capacity to model integrated waste management analysis and thus would be less likely to use it. In these terms, a positive correlation makes sense since the more complex the system is perceived, the more likely it is that it can handle the complex problems associated with waste management, and therefore the more likely it is that individuals may use it.

The negative correlation between compatibility (with software) and system use for the group of respondents who participated in a workshop, although not significant at -.1591, also warrants discussion. The negative relationship contradicts past research which suggests similar or compatible innovations will be implemented more readily. The negative correlation found in this study may suggest that WastePlan adopters perceive the need for a solid waste management decision support system that is different than other tools that may have been used previously. Thus, the more dissimilar adopters view WastePlan, the more capable it

may be perceived to address the challenging issues, and the more adopters may be willing to use it.

Interestingly, the attribute observability had an almost zero correlation with use, a surprising finding given the fact that, of the innovation attributes, workshop participants gave this attribute the highest overall rating. This finding suggests that while the workshop was successful in illustrating the usefulness of WastePlan (through observed results), ultimate system use may depend largely on variables other than observability.

Of the individual attributes (competence and need), the correlation coefficient for need was extremely strong and significant (at $p < .05$) for both groups of respondents. The coefficients of .6970 for Group A and .6738 for Group B, in fact, represented the highest correlation levels for both groups among all 13 attributes investigated. Therefore, more than any other single attribute, respondents' perceived need for WastePlan within their work as solid waste professionals was most closely associated with system use, independent of whether or not a workshop was attended. The correlation coefficient for the individual attribute competence, however, was not significant for either group of respondents, and in fact, was negatively correlated with use among the group of respondents who had participated in a

workshop. Given past research results, this finding is somewhat surprising, but suggests that use of WastePlan, albeit slight, at the time of the survey questionnaire was driven by factors unrelated to competence. This may, however, be a short-term phenomenon where use was motivated by other attributes such as the perceived need for the system. That is, a perceived need for WastePlan may have encouraged individuals to experiment with the system. Increased and long-term use of the system may be influenced to a greater degree by competence because unless a significant competence level is reached, individuals may experience frustration and an unwillingness to use WastePlan extensively.

Correlation coefficients for the organizational attributes were generally strong and significant (at $p < .05$) for both groups of respondents. Of the four attributes considered, three were significantly correlated within each group (see Figures 10 and 11, pp. 58 and 60 respectively). A perceived need for WastePlan analysis within respondents' regions of employment was highly correlated with use; .4512 for the group of respondents who did not participate in a workshop and .4448 for the group of respondents who did participate in a workshop. These high correlations suggest that external factors (pressures outside the immediate organizational sphere), such as landfill closures or

mandatory recycling programs, may be a highly motivating factor for WastePlan use.

Correlation coefficients among both groups of respondents were also quite strong for organizational commitment. This result suggests, quite reasonably, that use is associated with an organization's willingness to provide the technical resources and time needed for an implementor to utilize the system. Because the majority of respondents had access to an existing system that could accommodate WastePlan, this result may indicate that although an organizational commitment in favor of the system may not be sufficient for use, use may not be possible without it.

Results were mixed for the last two attributes considered in the analysis, management support and participation. Whereas participation was, but management support was not significantly correlated with system use among the group of respondents who did not participate in a workshop, the opposite case was found for the group of respondents who did participate in a workshop where management support was significantly correlated with system use but participation was not. Although inconclusive, these results, along with the mean scores discussed previously, may indicate that organizational attributes are more

significant in terms of establishing overall system interest which may lead to participation in workshops, but may not be sufficiently important to facilitate ultimate system use.

The correlation coefficients between groups were similar as indicated by results of the Z-tests (Figure 12, p.62). Of the 13 pairs of coefficients, only three: complexity, observability, and communicability were significantly different from each other. The difference between the correlation coefficients associated with complexity stems from the positive correlation found between complexity and system use for the group of respondents that participated in a workshop. The significant difference found between coefficients for observability and system use similarly seems to be a result of the low score obtained from individuals who participated in a workshop. Since explanations for these findings were advanced above, they will not be reiterated here. The significant difference found between coefficients for communicability, like that found for complexity, seems to be a result of the negative correlation associated with the group of individuals who participated in a workshop. Although past research suggests a positive relationship between communicability and implementation, the negative correlation found here suggests that WastePlan adopters may perceive a tool whose operating principles (know-how) are easily communicated to others to

be insufficient to handle the complexities associated with solid waste management planning. With reasoning similar to that offered for the counterintuitive correlation coefficient found for the variable complexity, it may be that, the more difficult it is to convey the operating principles of the innovation (Wasteplan), the greater the perception of utility and hence ultimate system use.

Chapter V: Summary and Conclusions

WastePlan, IBM-PC compatible decision support system software specifically designed for integrated solid waste management planning, has been distributed to 159 waste management professionals within the State of Michigan since 1989. Developed and distributed at great expense, the degree to which WastePlan has actually been used is not known, but of substantial interest to Tellus (WastePlan developers), the State of Michigan, and the United States Environmental Protection Agency who has partially funded WastePlan distribution in Michigan and is considering the system for national distribution. This thesis addresses WastePlan implementation, focusing specifically on the impact workshops have had on selected diffusion variables associated with innovational implementation. The following chapter includes a brief summary of the study, proposes conclusions and implications based on relevant findings, and offers recommendations for further study.

A. Summary of Procedures

The individuals participating in this research study included 80 solid waste management professionals, representing various levels of government as well as regional planning commissions, within the State of Michigan. Each participant had received WastePlan at least three months prior to the time at which data collection commenced, and 27 had previously taken part in a WastePlan workshop which trained individuals to use the system through a combination of lectures and problem solving exercises.

Data was obtained through a self-administered written questionnaire designed to measure respondents perceptions' of diffusion variables (independent variables) along with overall system use or implementation (dependent variable).[15] Each diffusion variable was represented by two statements (one stated positively, one stated negatively) and measured along a five-point likert-type scale. Four separate aspects of system use were similarly measured, and combined to form a composite scale representing the overall degree of implementation.

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[15] The survey questionnaire was originally sent to 140 waste management professionals. Eighty usable responses were obtained representing an overall response rate of 57 percent.

The following techniques were used to assess the impact of training workshops on the independent diffusion variables and ultimately on system use. First, t-tests were used to determine whether any significant differences existed in the perception of diffusion variables between the group of respondents who had not participated in a workshop and the group of respondents who had participated in a workshop. A t-test was similarly used to determine whether a significant difference existed in overall system use. Correlations coefficients were calculated to determine which, if any, of the diffusion variables were significantly correlated with system use for each group of respondents. Finally, Z-tests were used to determine whether any statistically significant differences existed between the correlation coefficients of each group.

B. Summary of Findings

Overall, little difference was found among the mean scores between groups for both the independent diffusion variables and system use. The majority of mean scores for the diffusion variables ranged between three and four. These scored indicated that respondents were between "undecided" and "somewhat agree" that the variables were associated with WastePlan. The only exceptions were for the innovation attribute complexity (mean scores for both groups

approximately 2.8) and the organizational attribute need (mean scores for both groups approximately 4.3). Mean scores were consistently higher, yet non-significant, for the group of individuals who had attended a workshop. The only attribute with a significant mean score difference between groups was observability, an innovation attribute, indicating that respondents who had participated in a workshop believed, more so than the group of respondents who had not participated in a workshop, that WastePlan's usefulness is apparent by observing results of system analysis.

Mean scores between groups for each aspect of use measured, varied only slightly, revealing non-significant differences. Overall mean scores (both groups) for the dependent variable were low (approximately 2.2 for both groups), indicating very low levels of actual use (as measured by the number of hours per week and percent of decisions incorporating WastePlan analysis), with somewhat higher levels of both satisfaction and intent to use the system in the future. These results are consistent with the non-significant mean score findings reviewed above. Since little difference was found among respondents' perceptions of the independent diffusion variables, no difference would be expected in system use.

Correlations between the diffusion variables and system use varied widely, although in only a few cases significantly, between the groups of respondents. In the case of respondents who had not participated in a workshop, all correlation coefficients were found in the expected direction and, furthermore ten of them were significant ($p < .05$). Correlation coefficients associated with the group of respondents that participated in a workshop, on the other hand, were for the most part not significant ($p < .05$), and four were in the opposite direction than that predicted by past research. Of the seven innovation attributes, six were significantly correlated with use for the former group, whereas only one was significantly correlated for the latter. The attributes significantly correlated with use for each group are noted in Figure 13. The individual attribute need was most highly correlated with use for both groups of respondents, .6970 for the group that did not participate in a workshop and .6738 for the group that did participate in a workshop.

C. Conclusions

Based upon the findings and within the limitations of this study, results suggest that the workshops had little, if any, impact on respondents' perceptions of diffusion variables associated with WastePlan. With few perceptual

Diffusion variables significantly correlated with use:	
Group A	**Group B**
Innovation attributes:	**Innovation attributes:**
Relative advantage Compatibility (with values) Complexity Trialability Observability Communicability	Relative advantage
Individual attributes:	**Individual attributes:**
Need	Need
Organizational attributes:	**Organizational attributes:**
Management support Organizational commitment Need	Participation Organizational commitment Need

Group A: Respondents that did not participate in a workshop
Group B: Respondents that did participate in a workshop

Figure 13. Significant Variable Correlation Summary.

differences, little differentiation in use would be expected, and, in fact, the findings verify this. Mean score differences among the four aspects of use and the composite indicator of use were minimal and non-significant, indicating no difference between groups in system use. Moreover, mean scores indicate no difference in actual use (measured in terms of hours of system use per week and percent of decisions made), satisfaction with the system, or intent to use the system in the future.

Correlations between independent diffusion variables and system use suggest somewhat different variables are associated with implementation for each group of respondents. Whereas nearly all of the innovation variables are associated with system use for the group of respondents that had not participated in a workshop, only relative advantage is significantly correlated with system use for the group of respondents that did participate in a workshop. Results indicating that the individual attribute need is most strongly associated with use for both groups, and that the majority of organizational attributes are highly correlated with use for both groups, suggests that use of WastePlan may depend more upon these attributes than those associated with the system itself (especially for the group of respondents that participated in a workshop). Thus, WastePlan use may be motivated more by the individual's

perceived need for such a system, the organization's willingness to provide the resources necessary for use, and external pressures requiring the analysis provided by the tool, than by the characteristics of the system itself, such as ease of use (low complexity) and similarity with other systems used previously (compatibility).

D. Discussion and Implications

Workshops were designed to provide training and experience to solid waste management professionals so the WastePlan decision support system could be used in future decisionmaking. Surveys conducted after the workshops indicated that participants were generally satisfied with the quality of the training provided and felt it was a worthwhile experience. Nonetheless, based on results obtained within this study, system use remained low for those individuals that participated in a workshop and furthermore, were not significantly different from those individuals that had not participated in workshop. The continuation of WastePlan training workshops, therefore, must be carefully considered, especially in light of the substantial costs involved, both in terms of the time (two to three days of training per workshop) and associated financial resources (e.g. Tellus trainers, computer facility, training materials, etc.).

A definitive decision to abandon training workshops altogether, however, may be somewhat premature. Based on the infrequent timing and overall limited number of waste management decisions (typically corresponding to mandated five-year plan updates or other unique mandated requirements such as a newly established recycling or composting program), system use may yet increase dramatically. Although results of this study clearly indicate extremely low present use levels, system satisfaction is at an intermediate level as is intent to use the system in the future.

Based on the results of this study, a decision to continue WastePlan training workshops should be designed within the following parameters. Workshops should, first of all, be offered a short time (perhaps three to six months) before mandatory updates are required. This timeframe will allow waste management planners sufficient time to gather any data necessary for analysis and incorporate the skills acquired in training while they are still fresh. Workshops should furthermore be designed to emphasize those diffusion attributes found in this study to be most highly and significantly correlated with system use including: relative advantage, individual need, and organizational need (the need within the target area of analysis). Workshops emphasizing these attributes would thus stress: the advantages and superiority of WastePlan as a waste

management tool, relative to other similarly designed systems and means of analysis (relative advantage), the high degree to which WastePlan meets the analysis needs of solid waste management planners (individual need), and the high degree to which WastePlan can model all scenarios of perceived importance to the area within which analysis will be applied (organizational need).

E. Recommendations for Further Study

Due to the fact that mandatory five-year waste management updates are not due for approximately two years, the impact of workshops on system use may continue to be studied shortly after plans are submitted for approval, thus providing the greatest opportunity to assess system use. This timing consideration becomes even more significant given the fact that some respondents only had access to WastePlan for a period of three months preceding this investigation. Although this is a sufficient amount of time to learn the system, actual use may have been reduced if data gathering (prior to analysis) was still underway. Continued investigation into the impact of workshops on implementation, additionally may be investigated over a longer period of time as complex decision support systems such as WastePlan often take years to fully implement or routinize within an organization.

Future research may focus on systematic differences in WastePlan implementation based upon the governmental level of individual adopters. Comparisons may be made, for example, by focusing on implementation within counties, cities, or townships (see p. 38 for a breakdown of WastePlan adopters by governmental level).

Continued investigation may, alternatively, focus on the free distribution of WastePlan within the State of Michigan. Since individuals were able to obtain the system at no cost, adoption may have been the result of a perceived future need for solid waste management planning or simply obtained in order to observe the latest technological advance in integrated solid waste management decision support software. A future study might attempt to identify the threshold level at which adopters would be willing to make an explicit financial outlay which may lead to an increase in the perceived value of the system, an increased sense of ownership, and increased management support and organizational commitment toward WastePlan.

Finally, future research may address the goodness-of-fit between WastePlan and its adopters. While results of this research clearly indicate a tool such as WastePlan is perceived to be useful, and a definite need for solid waste management planning, actual system use is low. The

possibility exists, therefore, that the problem may not be in workshops as a means of training, but rather that WastePlan, as designed, may not match the needs of adopters in some very important ways. A study designed to investigate the degree of fit and identify areas in which improvements are possible may prove very beneficial in future implementation efforts.

APPENDICES

APPENDIX A

APPENDIX A

Survey Questionnaire

WastePlan User Survey
August 1991

NOTE: If you are not the most active user of WastePlan in your organization (department), please give it to the person who most uses the program.

THIS QUESTIONNAIRE TAKES ONLY MINUTES TO COMPLETE. PLEASE COMPLETE IT NOW AND RETURN IT IN THE ENCLOSED STAMPED, SELF-ADDRESSED ENVELOPE.

- -

I. Each statement below precedes a rating scale with the following five responses:

SD -- strongly disagree
D -- disagree somewhat
N -- neutral or undecided
A -- agree somewhat
SA -- strongly agree

Please read each statement carefully and then circle the ONE response that most closely matches your feelings.

	strongly disagree	disagree somewhat	neutral/ undecided	agree somewhat	strongly agree
1. WastePlan is relatively difficult to understand and use.....	SD	D	N	A	SA
2. I believe I have all the skills and knowledge needed to utilize WastePlan effectively.....	SD	D	N	A	SA
3. WastePlan is a great asset to me in my work as a solid waste management professional.....	SD	D	N	A	SA
4. My supervisor is not very supportive of my WastePlan efforts.....	SD	D	N	A	SA
5. WastePlan use is easily explained to others.....	SD	D	N	A	SA
6. Use of WastePlan requires a great deal of personal and/or organizational change.....	SD	D	N	A	SA

please go to the next page

	strongly disagree	disagree somewhat	neutral/ undecided	agree somewhat	strongly agree
7. WastePlan may be tried on a limited basis before deciding whether or not to consistently incorporate it in my solid waste management planning.....	SD	D	N	A	SA
8. WastePlan's usefulness can be easily understood by serving the results of WastePlan analysis..	SD	D	N	A	SA
9. WastePlan offers no advantage relative to other tools used in solid waste management planning..	SD	D	N	A	SA
10. I was fully involved in the decision to attain WastePlan.....	SD	D	N	A	SA
11. WastePlan is easy to comprehend and utilize.....	SD	D	N	A	SA
12. WastePlan is very similar to other computer programs (not specifically waste management software) I have used previously.....	SD	D	N	A	SA
13. The city, county, region, etc. within which I engage in solid waste planning faces many solid waste management challenges.....	SD	D	N	A	SA
14. My organization has allocated all of the resources (computers, time, etc.) necessary for me to implement WastePlan.....	SD	D	N	A	SA
15. WastePlan cannot be experimented with before determining whether or not to use it on a regular basis.....	SD	D	N	A	SA

please go to the next page

	strongly disagree	disagree somewhat	neutral/ undecided	agree somewhat	strongly agree
16. I do not feel there is much need for WastePlan analysis within the city, county, region, etc. that I engage in solid waste management planning.....	SD	D	N	A	SA
17. I was not involved in the decision to adopt WastePlan.....	SD	D	N	A	SA
18. As a solid waste professional, I have little need for WastePlan.....	SD	D	N	A	SA
19. Observing WastePlan results would not help a potential user understand WastePlan's usefulness.....	SD	D	N	A	SA
20. My manager fully supports my WastePlan efforts...	SD	D	N	A	SA
21. WastePlan is superior to other tools that aid in solid waste management planning.....	SD	D	N	A	SA
22. I do not feel I possess the skills and knowledge necessary to effectively use WastePlan.....	SD	D	N	A	SA
23. My organization has not committed any resources (computers, time, etc.) that would help me utilize WastePlan.....	SD	D	N	A	SA
24. WastePlan use is difficult to explain to others..	SD	D	N	A	SA

please go to the next page

II. Each question below deals with WastePlan use. Please place a check mark in the ONE BOX, or circle the ONE NUMBER that best reflects your use of WastePlan.

On <u>average</u>, how many hours per week do you use WastePlan? (check one box)

[ ] I do not use WastePlan

[ ] Less than 2 hours per week

[ ] Between 2 and 5 hours per week

[ ] Between 5 and 10 hours per week

[ ] More than 10 hours per week

Since acquisition of WastePlan (V90-6), what percent of waste management <u>decisions</u> have included WastePlan analysis? (check one box)

[ ] Zero

[ ] Less than 25 percent

[ ] Between 25 and 50 percent

[ ] Between 50 and 75 percent

[ ] More than 75 percent

Overall, how satisfied are you with WastePlan as a solid waste management planning tool? (circle one number)

Not at all satisfied 1 2 3 4 5 Extremely satisfied

How likely do you feel it is that WastePlan will be a routine part of your future waste management planning and analyses? (circle one number)

Not at all likely 1 2 3 4 5 Extremely likely

THANK YOU FOR TAKING THE TIME TO FILL OUT THIS QUESTIONNAIRE. PLEASE FOLD, PLACE IN THE ENCLOSED STAMPED, SELF-ADDRESSED ENVELOPE, AND RETURN.

APPENDIX B

APPENDIX B

Survey Cover Letter

August 13, 1991

Dear WastePlan Licensee:

WE NEED YOUR HELP!

As a Michigan WastePlan licensee you are in a unique position to assist us in our continuing implementation efforts. While the enclosed questionnaire will only take minutes to complete, your answers will provide valuable and much needed information.

Like most questionnaires, there are no right or wrong answers; we are only interested in your honest responses (confidentiality guaranteed). Furthermore, your answers are very important to us *no matter how much or how little* you have used WastePlan.

Once you have completed the questionnaire, you may return it in the stamped, self-addressed envelope which has been provided for your convenience. As a token of our appreciation, we will send you, both the Recycling Wheel and the Household Hazardous Waste Wheel (below) which are fun and innovative tools that provide quick access to detailed and useful waste management information.

Please accept our thanks in advance for your time and for helping us in our Michigan WastePlan implementation efforts.

Truly,

Gary Meyer
Michigan WastePlan Coordinator

enclosure

APPENDIX C

APPENDIX C

Follow-up Survey Cover Letter

August 26, 1991

Dear WastePlan Licensee:

I DESPERATELY need your help!

Approximately two weeks ago I sent a questionnaire regarding the WastePlan computer software program. To date I have not received yours back in the mail.

Your response to the questionnaire, EVEN IF YOU HAVE NEVER USED THE WASTEPLAN PROGRAM, is very important both to the Michigan WastePlan Project, as we continue our implementation efforts, and to me personally (not to mention my thesis committee) as I forge ahead with my Master's thesis.

From past experiences with survey questionnaires, I know how easily they can be inappropriately routed or misplaced. I have therefore enclosed another copy of the survey along with a stamped, self-addressed envelope for your convenience, and ask for just a few minutes of your time to complete and return it.

To express our gratitude, you will be sent both the Recycling Wheel and the Household Hazardous Waste Wheel (below); fun and innovative tools that provide quick access to detailed and useful waste management information.

If I do not receive your survey back by Wednesday, September 4, I will call to see if you need any assistance. If you have already sent the questionnaire back, please accept my thanks, if not, PLEASE do so now. Your response is greatly appreciated!

Sincerely,

Gary Meyer
MSU WastePlan Coordinator

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LIST OF REFERENCES

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