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Overcoming Barriers to Pollution Prevention in Small Businesses

Applications in the Metal Parts Fabrication Industry

Thomas J. Bierma
Francis L. Waterstraat

Illinois State University

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Overcoming Barriers to Pollution Prevention in Small Businesses: Applications in the Metal Parts Fabricating Industry

by

Thomas J. Bierma,
Francis L. Waterstraat,
Department of Health Sciences
Illinois State University
Normal, Illinois 61761

Prepared for

Illinois Hazardous Waste Research and Information Center
One East Hazelwood Drive
Champaign, IL 61820

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LIST OF ABBREVIATIONS

CNC - Computer Numeric Controlled

MPF - Metal Parts Fabricating

P2 - Pollution Prevention

POTW - Publicly Owned Treatment Works

SIC - Standard Industrial Classification

USEPA - U S Environmental Protection Agency

ABSTRACT

The purpose of this research was to answer two fundamental questions:

1. Why is business adopting pollution prevention (P2) so slowly despite the financial and environmental benefits of P2 and the extensive promotion efforts of federal, state and local government?

2. What strategies could be used to significantly accelerate the adoption of P2 by business?

The researchers employed telephone and personal interviews to study small businesses in metal parts fabricating (MPF) industry in the state of Illinois. The researchers found that the business conditions are very good for P2 diffusion, but the diffusion is limited. MPF managers are demanding manufacturing innovations, but they are not seeking P2 innovations. Current formal and informal industry communication channels are not promoting P2, while government efforts to promote P2 are having limited effect.

Results suggest that there are three primary reasons for these problems:

1. For technology transfer, MPF managers utilize a small network of trusted business acquaintances to obtain data on new technologies. These trusted business acquaintances within the manager's "comfort zone" include suppliers, competitors, customers and contracted business associates (i.e. accountants, attorneys, etc.). Government programs (including those promoting P2) are in the MPF managers' "danger zone", and managers actively avoid contact with such groups.

2. MPF managers do not recognize the financial benefits of P2, due to limited accounting systems which do not track waste costs.

3. The P2 language is not consistent with business language, resulting in the P2 promotion information being misinterpreted and misunderstood by the MPF managers.

The researchers provide a number of recommendations for improving P2 promotion which include revising accounting methods, utilizing existing individuals in the MPF managers' "comfort zone" to promote P2, and changing the P2 language.

EXECUTIVE SUMMARY

PURPOSE

The study of barriers to the adoption of pollution prevention (P2) by small businesses was motivated by two questions:

1. Why is business adopting pollution prevention (P2) so slowly despite the financial and environmental benefits of P2 and the extensive P2 promotion efforts of federal, state, and local governments?
2. What strategies could be used to significantly accelerate the adoption of P2 by businesses?

The scope of this research was limited to small businesses (roughly, under 200 employees) in the metal parts fabricating (MPF) industry in Illinois. The answers to the two questions above were pursued through examining the means by which other manufacturing innovations were adopted; that is, how technology transfer typically occurs in the MPF industry. Differences between P2 and these other technologies were then explored.

METHODS

Understanding typical technology transfer mechanisms in the Metal Parts Fabricating (MPF) industry, and the barriers to the transfer of P2 technology, required the use of a wide variety of information courses:

1) The marketing literature, particularly Diffusion of Innovations, to identify the mechanisms by which technologies typically "diffuse" through a population of businesses and how the rate of diffusion can be inhibited or enhanced
2) The literature on barriers to manufacturing assistance for small businesses (government programs to promote manufacturing modernization), to identify common difficulties in the promotion of technological change.
3) The literature on barriers to pollution prevention, to identify the difficulties that others have found in promoting P2
4) Telephone interviews with personnel from manufacturing and P2 assistance programs, to identify current opinion on the factors which inhibit or enhance the rate of P2 adoption
5) The literature of metal parts fabricating, to identify the current state of the industry, its customers, its suppliers, and future trends.
6) Telephone interviews with Illinois MPF companies, to identify common technology transfer mechanisms and determine the perceptions of P2 in the MPFs.
7) On-site interviews with selected Illinois MPF companies to develop a more detailed picture of the means by which new technologies are identified and adopted

FINDINGS AND CONCLUSIONS

Conditions for P2 diffusion appear to be good, yet diffusion is very limited

Communications with federal and state P2 assistance personnel confirm that they believe P2 technologies are effective, profitable and affordable for nearly all small MPF companies. P2 in the MPF industry has received considerable attention in P2 promotion efforts. Our contacts with the industry indicate that, though the MPF industry is mature, it is experiencing strong demand for its products. New technologies which improve productivity and profitability, such as computer numeric controlled (CNC) machines, have widely diffused through the industry in the last decade. Given these factors, P2 technology would be expected to diffuse rapidly through the MPF industry, as well. However, federal and state personnel agree that P2 adoption in small businesses, including MPF companies, has only "scratched the surface".

Though MPF managers are demanding other manufacturing innovations, they are not demanding P2 innovations

This lack of demand for P2 innovations appears to be due to two primary factors. First, those who are promoting P2 are not speaking the language of business. The current language of P2 is perceived by managers to address "environmental problems". These are seen as tangential to their primary concern: productivity and profitability. Though P2 addresses these core business concerns, the language currently in use does not establish that connection in the mind of the small MPF manager.

Second, managers greatly underestimate their production waste and the financial impact of that waste on the company. Current managerial accounting practices fail to capture the volumes and costs of production wastes. As a result, managers fail to recognize the benefits of reducing such wastes.

Familiar technology transfer mechanisms are not promoting P2

Small MPFs typically adopt new technologies by seeking information from a well established set of sources. These sources comprise a manager's "comfort zone" of professionally trusted individuals: suppliers, competitors, customers, and contracted business associates (accountants, attorney's, etc.). None of these has P2 expertise or experience. In addition, because P2 is not being demanded by MPF managers, none of these sources is receiving market signals to develop P2 expertise. Thus, the established technology transfer mechanisms that MPFs use are not providing information or assistance in waste minimization.

Government-driven P2 technology transfer mechanisms have limited effectiveness

Mechanisms established by governmental agencies to promote P2 technology transfer have limited effectiveness because they are external to the "comfort zone". In fact,

government agencies and consultants are in most managers' "danger zone". Managers do not trust members of the "danger zone" and actively avoid communications with them.

Thus, those who are trusted (the "comfort zone") do not have P2 expertise, while those who have the P2 expertise are not trusted by MPF managers. In addition, "marketing" strategies used to promote P2 often use techniques which are inconsistent with the needs and traditions of the business managers they are attempting to reach. Such strategies are ineffective in motivating interest in P2.

RECOMMENDATIONS

Approach P2 promotion as a marketing problem

To increase the rate of pollution prevention adoption, one must understand the factors governing technology diffusion and how to manage those factors. If we leave diffusion to chance, it is likely to be limited and slow. Adoption of P2 is similar to the adoption of any new idea or commodity; it requires the right product at the right price. Communication about the product must come through accepted channels from trusted sources. An effective marketing program requires a clear understanding of the customer, as well as the differences and similarities between types of customers.

Enhance traditional P2 promotion program through marketing insights

Direct assistance can be enhanced primarily through two changes in strategy.

- **Use trusted communication sources** - If government agencies are to provide P2 expertise to small businesses, the best way to reach the small business manager is through the "comfort zone" members. Suppliers, competitors, and customers may provide the needed introductions to managers.

- **Change the P2 language** - Substitutes for the current P2 language must be found. Terms such as "environment", "pollution", "hazardous waste", and even "waste minimization" should be avoided.

Use non-traditional mechanisms for promoting P2

Agencies desiring to obtain the greatest diffusion of P2 with existing resources should try non-traditional mechanisms such as providing P2 assistance through non-governmental organizations. Such mechanisms will require an essential, though significantly different, role for P2 assistance personnel, and will need to take advantage of market forces and structures in an industry.

- **Use the Supplier/MPF relationship** - Suppliers are the most trusted source of innovation information for most small MPFs. The supplier/MPF relationship is often long-term and personal. For some suppliers, P2 may be a logical and profitable extension of current services.

- **Use the Accountant/MPF relationship** - One of the most significant barriers to P2 adoption is manager ignorance of waste volumes and associated costs. Ignorance occurs because information available to the managers includes little or no information on wastes. The accountant/MPF relationship offers an opportunity to implement more effective accounting methods for monitoring the cost of waste.

- **Use relationships among competitors and other local businesses** - Small businesses depend upon other businesses, including competitors, for assistance and advice in adopting new ideas and technologies. This informal communication network provides many opportunities for promoting the exchange of P2 information among these businesses.

- **Use the Customer/MPF relationship** - Some large manufactures have required their suppliers to implement quality improvement and cost reduction programs. A similar model could be used for environmental performance.

- **Expand availability of capital** - External funding may not be available to some businesses because lending institutions may be attempting to minimize financial risk by avoiding certain types of businesses or business activities. It may be necessary to identify sources of misunderstanding in the banking industry and provide education on the value of pollution prevention investments. Supplemental incentives for P2 loans may ultimately be needed.

CHAPTER 1

INTRODUCTORY MATERIAL

The study of barriers to the adoption of pollution prevention (P2) by small businesses was motivated by two problems·

1 Despite the profitability of pollution prevention (P2), and considerable effort from federal, state, and local government entities, P2 is being adopted very slowly by industry Adoption appears to be particularly slow in small businesses

2 The number of small businesses which could benefit from P2 greatly exceeds the resources available for direct assistance In most states, tens of thousands of small businesses need pollution prevention assistance. Current resources for direct assistance generally cannot help more than several hundred businesses per year in each state

Thus, the purpose of this research was to answer two questions

1. Why is business adopting pollution prevention (P2) so slowly despite the financial and environmental benefits of P2 and the extensive P2 promotion efforts of federal, state, and local governments?

2 What strategies could be used to significantly accelerate the adoption of P2 by businesses?

We approached both study questions from a marketing perspective. P2 is a product The objective of P2 promotion programs is to maximize adoption of this product Extensive experience on marketing products, both tangible and intangible (ideas), is available in the marketing and behavioral sciences literature A marketing framework provides answers to what factors govern adoption and how to manage those factors to produce the most widespread and rapid adoption Chapter 3 provides the foundation for this marketing perspective.

The scope of this study was limited to the metal parts fabricating (MPF) industry (SIC 34) The limited scope allowed more in-depth research, providing a better understanding of basic motivations and concerns of small business managers In particular, it allowed us to focus on how technology transfer typically occurs in small MPFs

Illinois has over 2,500 MPF companies, 90% of which have fewer than 100 employees (US Bureau of the Census, 1990) A wide array of processes are used in fabricating metal parts , though the study focuses primarily on metal shaping (cutting, milling, drilling, bending, etc),

cleaning, and painting Wastestreams include waste metal, metal working fluids, cleaning media (solvents, acids, caustics, abrasives, water), paints and other coatings, and packaging materials (USEPA, 1990). Opportunities for reducing the generation of these wastes are numerous and potentially quite profitable for the small MPF (USEPA, 1990) Our contacts with pollution prevention assistance programs confirm that nearly all small MPFs should be able to realize at least an annual return of $5,000-$10,000 for a P2 investment with a payback period of under two years. A large percentage of firms would realize much greater returns

Though the scope of this study was limited to the metal parts fabricating industry, the findings should be applicable to many industries dominated by small businesses. The processes used in the MPF industry (cleaning, painting, etc) are common to other industries. The problems faced by MPF managers (productivity, competition, innovation, labor, regulation, etc.) are faced by most other small manufactures. Many of our findings are also quite relevant to mid-size and large companies.

CHAPTER 2

METHODOLOGY

Understanding typical technology transfer mechanisms in the Metal Parts Fabricating (MPF) industry, and the barriers to the transfer of P2 technology, required the use of a wide variety of information courses

1) **The marketing literature** - to identify the mechanisms by which technologies typically diffuse through a population of businesses and how the rate of diffusion can be inhibited or enhanced Of particular value was work in the field of Diffusion of Innovations, the study of how new ideas and technologies diffuse through a population

2) **The literature on barriers to manufacturing assistance for small businesses** - to identify common difficulties in the promotion of technological change Recent work by the National Institute of Standards and Technology was particularly informative

3) **The literature on barriers to pollution prevention** - to identify the difficulties that others have found in promoting P2 A number of reviews of P2 barriers have been published.

4) **Telephone interviews with manufacturing and P2 assistance programs** - to identify current opinion on the factors which inhibit or enhance the rate of P2 adoption This included more than 20 contacts with federal, state and non-profit organizations which offer manufacturing or pollution prevention assistance to small businesses

5) **The literature of the metal parts fabricating industry** - to identify current and future trends in the health of the industry, its suppliers, and its customers.

6) **Telephone interviews with Illinois MPF companies** - to identify common technology transfer mechanisms and determine common perceptions of P2 Contacts were identified through the Illinois Hazardous Waste Research and Information Center, published manufacturing directories, and company-to-company referrals We completed telephone interviews with 12 MPFs. No attempt was made to draw a random sample from MPFs in the state since response bias was likely to be extreme. We believed that working from referrals would increase the likelihood of participation, thus reducing response bias. However, we recognized that even *with* this technique, respondents were likely to be the more innovative firms. Our observations were consistent with this In many companies, the manager could not be reached, refused interviews, or indicated that waste minimization was not a concern. Companies completing the interviews tended to have a stronger interest or sense of accomplishment in waste minimization. We considered this bias when conducting interviews and drawing conclusions

In addition, because this is a qualitative research study, consistency of response determines sample size. Though we had a diverse group of MPFs, ranging from screw machine shops to tube and sheet metal shops, the responses of our twelve interviewees were very consistent.

7) **On-site interviews with selected Illinois MPF companies** - to develop a more detailed picture of the means by which new technologies are identified and adopted Of the 12 MPFs interviewed by phone, six were interviewed extensively in person at the company site Interviews were conducted by both investigators and lasted from two to five hours. An extensive on-site interview was also conducted with a large Midwest metal supplier.

CHAPTER 3

MARKETING AND POLLUTION PREVENTION

3.1 INTRODUCTION

Pollution prevention (P2) is being adopted by the business community at a rate far slower than would be expected, given its merits as sound manufacturing practice, its benefits in cost control and environmental protection, and the significant efforts of federal, state, and local P2 programs. Many government programs have experienced the frustration of preparing mailings, brochures, workshops, and other materials for businesses, to find that few, if any, businesses were interested. Surprisingly, history shows that most good ideas are adopted very slowly. The problem is one of marketing; not marketing in the narrow sense of "pushing a sale", but rather integrating the right product, at the right price, in the right place, and communicating this information effectively (Table 1)

Diffusion of Innovations is a marketing approach that is particularly valuable for understanding the adoption of P2 practices. It is a field of study devoted to understanding the process and dynamics of how innovative ideas spread, or diffuse, through a population. It has produced not only a model of the typical diffusion process, but has identified a number of factors which promote or inhibit the diffusion. These insights can be translated into actions to increase the rate of P2 adoption.

Diffusion of Innovations research, which began in the early part of this century, has examined the diffusion of ideas as varied as agricultural practices, birth control, and oral rehydration therapy. Though many researchers have contributed to and applied the body of research on Diffusion of Innovations, the fundamental principles are best presented in the work of Everett M Rogers. His seminal text, *Diffusion of Innovations,* will serve as the foundation from which we will work (Rogers, 1983)

3.2 UNDERSTANDING THE P2 CUSTOMER

Diffusion of Innovations research has focused largely upon the behavior of individuals, rather than organizations. Organizations may behave differently Barriers to the adoption of P2 arising from conditions within large organizations, such as internal conflict and lack of communication, are well known (Kalavapudi, M 1995, McDonald 1991) However, most small businesses are dominated by a sole owner/operator, or a very small number of managers. The behavior of small businesses more closely resembles the behavior of individuals than it does the behavior of large, complex organizations.

Table 1. Elements of the Marketing Mix and Possible Applications to Pollution Prevention

	Commercial Marketing Application	*Pollution Prevention Application*
PRODUCT	Product is the combination of quality attributes which the customer ascribes to the product and which relate to the customer's needs. This can include such things as usefulness, reliability, color, image, service, packaging, etc It represents all of those attributes associated with the product that are of value (positively or negatively) to the customer Products with attributes best meeting the needs of the customers are most likely to be purchased.	Product is more than the technical attributes of the P2 technology It is those attributes which relate to the full range of customer needs including corporate competitive strategy (price, quality, innovation, efficiency, tradition, etc), business operations (decision-making structure, financial position, quality control, etc.), and functional operations (technical expertise, cost control, production scheduling, etc) Attributes such as trialability, which minimize risk, are also important
PRICE	Price not only represents the cost of purchasing the product, but time, effort, uncertainty, or other sacrifices which the customer perceives are necessary to obtain the product. In general, among similar products, that product with the lowest price is most likely to be purchased. However, for some products, high price may be a quality attribute for which the customer is willing to pay.	The capital, operating, and maintenance costs of a P2 technology are an obvious cost. However, many other costs may also be salient Risk likely plays a significant role in P2 adoption decisions Such risks may include the effectiveness of the technology, effects on product quality, dependability, future regulatory requirements, etc. Risks are likely to be larger when the technology is complex.
PLACE	Place represents the place, timing, or method by which the customer can obtain the product or product information. It can vary from a 24-hour telephone ordering service with delivery to the door, to temporary marketing locations at a great distance from home or work The more conveniently a product can be obtained, the more likely it is to be purchased.	Due to the risks inherent in many P2 technologies, prospective adopters are likely to seek information to reduce those risks The logistical difficulties in obtaining this information can impact the rate of adoption Places, times, and methods convenient to the prospective adopter, where "hands on" experience can be obtained, should enhance the diffusion process.
PROMOTION	Promotion includes all aspects of communication about a product. Though we traditionally think of promotion through mass media, communications about a product take a wide variety of forms including conversations among friends. Three components of communication are particularly important Source, Channel, and Message.	Promotion should be closely linked to market segment, including the stage in the adoption process and the company's view of innovation
Source	The source of a message should be trusted, credible, and familiar.	Use Opinion Leaders - actual or perceived peers, including "comfort zone" members
Channel	The channel through which the message is communicated should also be familiar and appropriate to the message. It should reach the target audience	Use mass communication for initial communication of knowledge about P2, but personal communication for the persuasion and personal need stages in adoption
Message	The message should be understandable and attractive to the target audience. It may be informative or persuasive	The P2 message should promote movement to the next stage in the adoption process. It may focus only on the need for P2 rather than the technology

In any population, different individuals will approach opportunities for change (innovations) in different ways, and all individuals will progress through a series of stages in their final decision to adopt, or reject, an innovation Diffusion of Innovations provides a framework for applying this knowledge of the customer to the adoption of P2

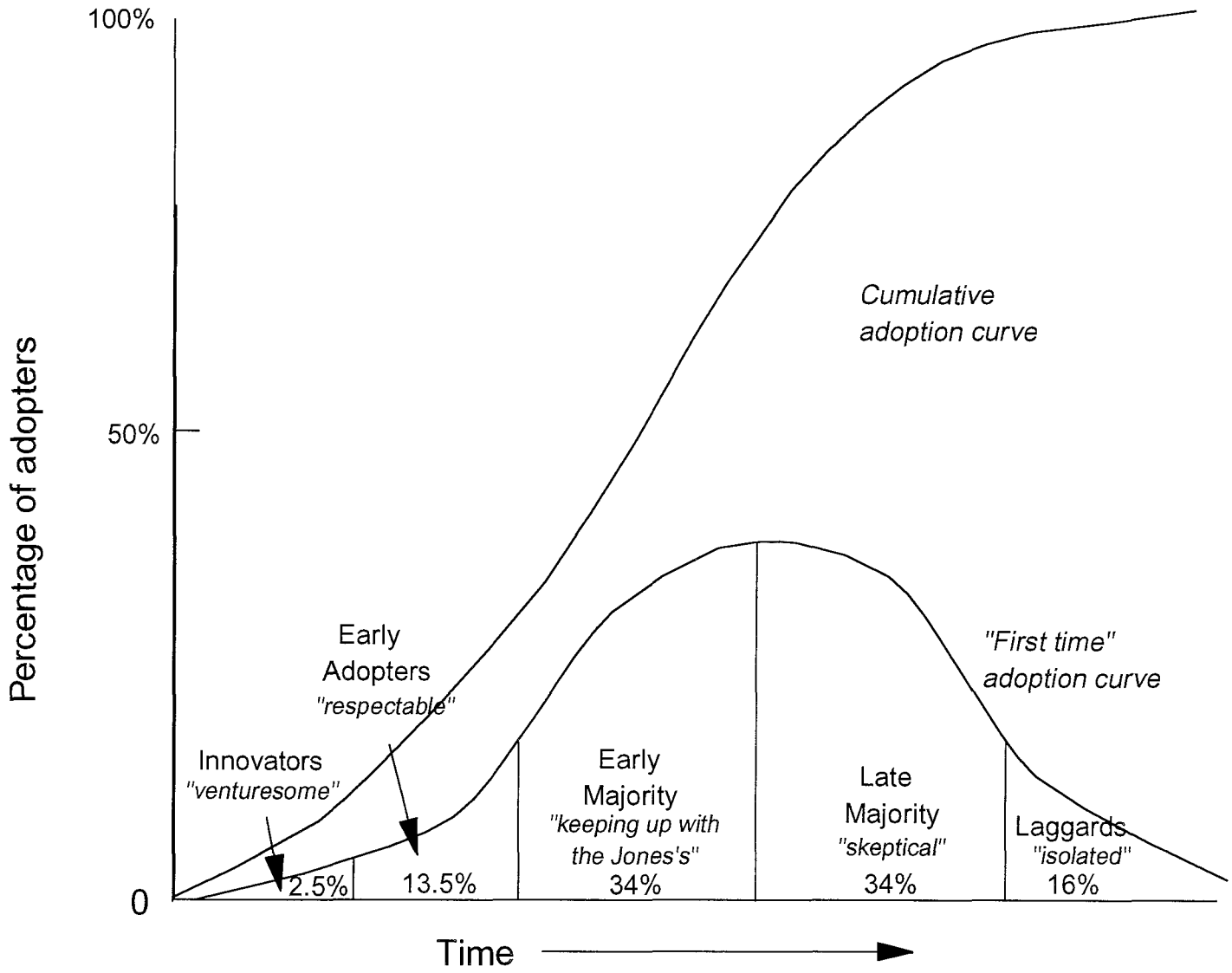
3.2.1 Customer Categories (by "innovativeness")

Figure 1 displays the classic s-shaped curve for the cumulative adoption of any innovation, indicating a relatively slow initial rate of adoption, a more rapid adoption rate for the majority of adopters, and a slowing adoption rate as the innovation approaches 100% acceptance. This pattern is not only applicable to the adoption of new ideas, but to most commercial products as well The slope of the s-shaped curve indicates the rate at which innovations diffuse through a population. Rapidly diffusing innovations, such as clothing fashions, may approach 100% adoption within months and will have a very steep diffusion curve Others, particularly "preventive" innovations, such as seat belt use, dietary changes, smoking cessation, etc , may require decades to approach 100% diffusion, and are characterized by very flat diffusion curves. It is clear from the history of P2 technologies that most have rather flat diffusion curves, with diffusion rates measured in years rather than months.

Also illustrated is the pattern of "first time" adopters Based upon studies in a wide variety of public and private sectors, adopters are often grouped into five categories. 1) *innovators*, 2) *early adopters*, 3) *early majority*, 4) *late majority*, and 5) *laggards* We will examine the nature of these different adopter categories below, but there is no guarantee that an innovation will ultimately progress to 100% adoption Many innovations, as well as many new commercial products, "die out" after adoption by only a minority of the population "Innovators", the first to adopt new ideas, are often easily persuaded to adopt innovations The remainder of the population, however, is not so easily convinced of the value of the innovation, and many innovations hit a "brick wall" at about 2-3% adoption. On the other hand, once voluntary adoption exceeds about 10-15%, the adoption of some innovations accelerates without additional promotion efforts This "diffusion effect" is a result of a change in social norms to favor the innovation, which increases peer pressure to adopt As discussed later, there are barriers which may inhibit this "diffusion effect" for P2. The lesson for P2 promotion is that adoption by the first 2-3% of the business community is easy; adoption by 10-15% and beyond is going to be much more difficult

Innovators may be characterized as "venturesome". They tend to have both the interest and resources to take considerable risk. Some innovations may be attractive to *innovators* largely because they are novel and risky. *Early adopters* are more a part of the mainstream Though they are very open to change and innovation, they are more risk-averse, and are therefore more respected by the majority of the population. *Early adopters* often hold an informal leadership role in the diffusion of new ideas. The e*arly majority* are well informed but generally consider new technologies too risky until proven by others. However, the *early majority* wish to avoid being "left behind" in the move to a new idea. It is the adoption of an innovation by the early majority that often coincides with a dramatic increase in its rate of diffusion throughout a population. The *late majority* are skeptical of change They may wait until change is a necessity and clearly

Figure 1. Pattern of Cummulative and "First Time" Adoption Over Time.



supported by social norms. Rogers notes, "[t]hey can be persuaded of the utility of new ideas, but the pressure of peers is necessary to motivate adoption" (Rogers 1983 p250). *Laggards* tend to be socially isolated and have limited communication networks. They tend to be rigidly focused on the past and are more interested in maintaining past practices than preparing for the future

Several other generalizations from Diffusion of Innovations research are also useful Earlier adopters tend to have a more favorable attitude toward science and technology than later adopters Earlier adopters tend to be less fatalistic than later adopters, that is, earlier adopters perceive having greater control over their future. Earlier adopters tend to have both higher aspirations and higher levels of achievement motivation than later adopters In other words, later adopters are motivated more by the avoidance of failure, while early adopters are motivated more by the opportunity for greater success. Earlier adopters tend to be more socially connected, enjoy a wider communication network, have greater contact with mass media, and are more open to communication with individuals different from themselves

This has important implications for government programs promoting the diffusion of P2. Businesses which contact state or local assistance programs and adopt P2 innovations are likely to be *innovators*, since they seek change and are open to communication with individuals different from themselves However, the impressions gained through contact with *innovators* may be misleading, since *innovators* are very different from the remainder of the business population It is most important that programs target *early adopters* because other businesses view them as having similar needs and concerns Yet, even adoption of P2 by the early adopters may not produce the "diffusion effect" (the spontaneous diffusion throughout the remainder of the population). This is because competition inhibits communication among companies, and communication networks may be quite limited for small to mid-sized businesses. Government programs may need to promote diffusion of P2 through all customer categories. This means developing different marketing strategies for each customer category (this is known as "market segmentation"). Each strategy must address the needs and concerns of that segment.

3.2.2 Stages in the Adoption Process

Individuals pass through a series of stages prior to, and following, adoption Figure 2 presents one conception of these stages. It is composed of two distinct sets of steps. In the upper portion of the figure are stages related to learning about the innovation. These are adapted from Diffusion of Innovations (Rogers 1983). In the lower portion of the figure are stages related to recognition of the need for the innovation. These are adapted from research on prevention behaviors (Weinstein 1988). From (0) a state of ignorance, an individual (1) receives knowledge of an innovation The individual must then decide whether there is a personal need for such an innovation. Typically, the individual is (2) aware that some people *believe* they have a particular problem or need In time, the individual recognizes that (3) other people probably *do* have this need Eventually the individual understands that (4) he or she probably also has that need. A period of (5) persuasion then follows during which the individual seeks information to reduce uncertainty about the innovation. Finally, (6) a decision is made either to adopt or reject the

innovation and (7) that decision is implemented (adoption). This may be followed by (8) a confirmation stage in which the decision may be affirmed or reversed.

Not only are the stages related to knowledge about the innovation quite distinct from those related to need for the innovation, but the individual's information needs are different at each stage For example, information on the specifications of a particular P2 technology may not be very important to an individual who believes that only others may need P2 technology. Market segmentation, the use of different marketing strategies for different customer segments, is necessary to address the needs of customers at different stages in the adoption process In particular, to increase the rate of P2 adoption, marketing strategies must emphasize those factors which promote movement through each stage, and minimize those factors which inhibit movement through each stage.

3.2.3 Multiple Needs

All businesses need to reduce costs and improve profitability These are important needs which P2 can help meet But business decision-makers have a diversity of needs which go beyond these Examples include product quality, security (reduced risk), adequate cash flow; market share, customer, employee, and public relations; corporate and personal image, and power In addition, the needs of businesses reflect more than the needs of a single individual Groups of individuals will often be involved in purchase decisions, and individuals at different levels in the organization will influence the division in the different ways (Berrigan and Finkbeiner 1992)

P2 can impact a wide variety of needs for a wide variety of individuals in an organization For example, P2 can reduce the regulatory burden on a company (Byers 1991), reduce risk associated with environmental compliance and liability, improve employee and public relations, improve cash flow, and enhance personal image However, P2 has the potential to negatively impact these and other needs as well. Some P2 technologies can be risky, decrease cash flow, decrease product quality, disrupt operations, complicate regulatory compliance (Byers 1991) or otherwise aggravate business problems. Marketing strategies must emphasize the ability of P2 to meet needs, and assist the prospective customer in minimizing any negative impacts

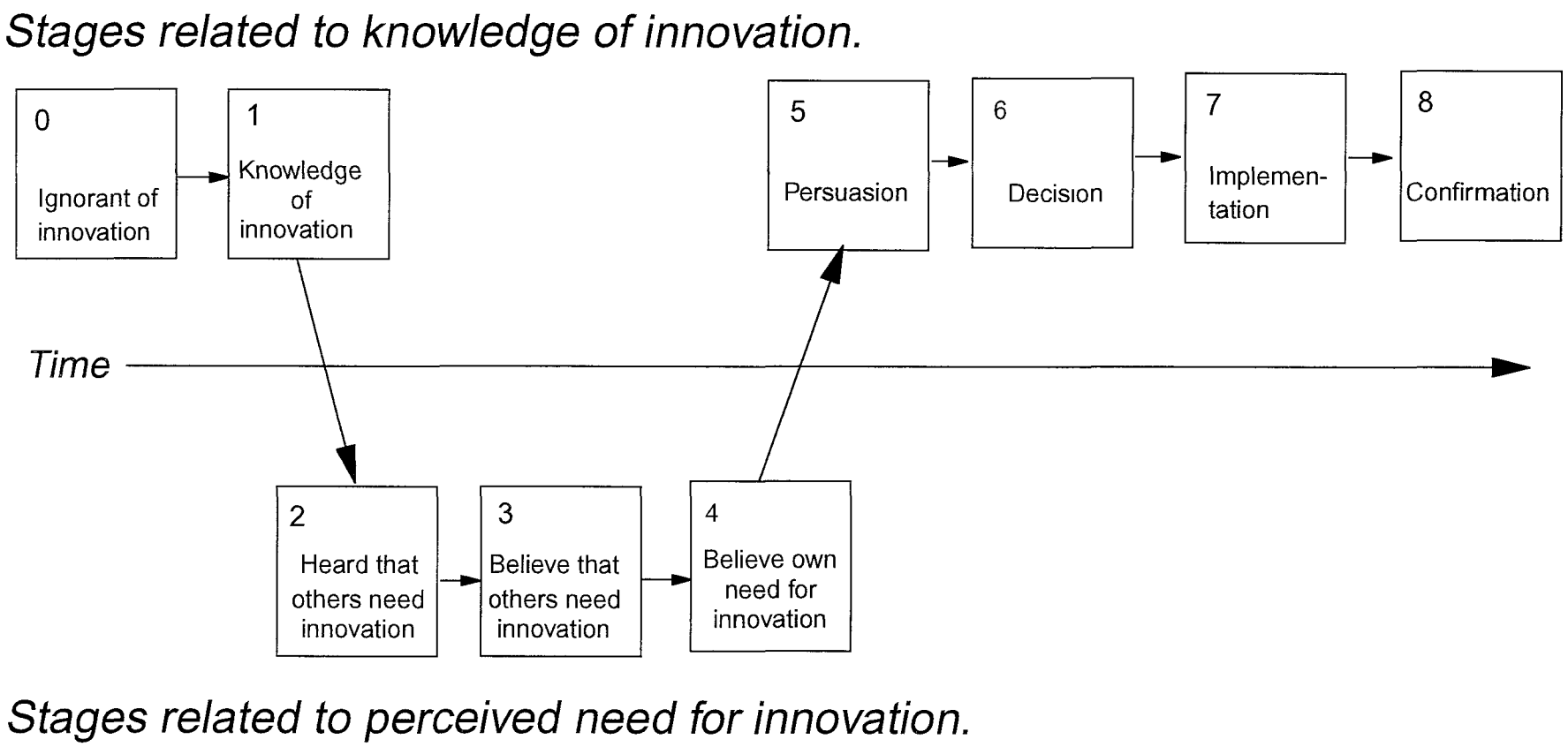
3.3 UNDERSTANDING THE CHARACTERISTICS OF P2 TECHNOLOGY

The characteristics of an innovation influence its rate of adoption These characteristics are categorized as *benefits*: attributes which meet business needs, *barriers* attributes which produce or aggravate business problems, and *risks*: attributes which represent uncertainties associated with the innovation

3.3.1 Benefits

The cost and waste minimization benefits of P2 may be obvious to those promoting P2, but may not be as obvious to the potential customer. Many companies, particularly small and mid-sized businesses, have neither the materials- or cost-accounting systems to identify the impact

Figure 2. Stages in the innovation adoption process.



of wastestreams (Kalavapudi 1995). Underestimation of waste costs should be an important target for marketing strategies intended to move a business to the stage of recognizing its own need for P2 (Stage 4 in Figure 2)

As discussed above, the needs of potential customers go well beyond cost reduction Different P2 technologies will provide greater benefits to different customer segments, depending upon the needs of that segment and the characteristics of the P2 technology The relative advantage of each P2 technology can be a valuable component of the marketing strategy

3.3.2 Barriers

Some P2 technologies are too complex for a given business In general, the simpler the technology, the more likely it is to be adopted. New P2 technologies are often initially applied in companies with the assistance of government programs These partnerships represent opportunities to simplify technologies before they are introduced to the rest of the business community

Some P2 technologies may be incompatible with the operations, resources, or culture of a company. For example, a P2 technology which requires the training and cooperation of line employees will not be attractive to a company with a culture that does not seek employee participation. A company without experience in chemicals processing may be hesitant to adopt a solvent recovery technology.

Finally, small and mid-size businesses may be unable to secure the capital needed for some P2 investments Part of the P2 "product" may need to be opportunities for financing. Additional government effort is needed make commercial loans more accessible for P2 initiatives

3.3.3 Risk

Businesses attempt to minimize unnecessary risk There are characteristics of P2 technologies which can either increase or decrease perceived risk, thereby increasing or decreasing the likelihood of adoption. If the benefits of a P2 innovation are observable by others, the innovation is more likely to be adopted by others. This requires making the benefits more observable (such as through better materials- and cost-accounting systems), and enabling others to observe them The latter requires sharing company information with other companies, many of whom may be competitors This is no small hurdle, yet many competitors regularly share basic information on new technologies, being careful not to divulge specific information which might significantly compromise competitive position The communication of general information about the success and benefits of a new technology can reduce perceived risk and contribute to the adoption of the technology by others. Government programs should take advantage of existing opportunities to exchange such information, including trade group meetings or supplier-sponsored events

Risk can also be reduced if a P2 technology can be tried on a limited basis, or if the risk can be shared with others. The former is a common technique used in "solvent expo's " Companies can bring their own parts to be test cleaned by various vendors. Similarly, opportunities to introduce a P2 technology in a limited, stepwise fashion reduces the potential impact of failure Risks can also be shared with others through contractual partnerships between suppliers and users, where both have an incentive to implement a successful program. Promising examples include the innovative partnerships between GM and some of its chemical suppliers (Williams et al 1995)

3.4 COMMUNICATE EFFECTIVELY

Communication of information is an important factor influencing the diffusion of an innovation. Important not only is the content of the information, but also the channel through which it is communicated and the source from which it comes.

Much of the preceding discussion involved the *content* of communication. The content can be communicated through *channels* which range from a "one-to-many", mass media approach to a "one-on-one", interpersonal approach "One-to-many" approaches are often only effective for individuals in the early stages of the adoption process (Figure 2). Interpersonal channels are important throughout, and are dominant in the later stages of adoption.

Of greatest importance, however, is the *source* of the communication Business managers are extremely busy and risk-averse Sources of communication which are trusted will be far more effective than sources which are not trusted or unknown. The most effective sources of information on innovations are known as *opinion leaders* Opinion leaders tend to be perceived as similar to the potential adopter, but slightly more competent, knowledgeable, or experienced Opinion leaders may not formally hold any special status in a social or business network, but nevertheless are accorded a higher informal status by other network members. *Innovators*, the first 2-3% of the population to adopt an innovation, are rarely seen as opinion leaders because they are perceived as being very different from most potential adopters The *Early Adopters*, however, are often perceived as far more "mainstream" and can make very effective opinion leaders, particularly for the *Early Majority*.

The support of opinion leaders can be extremely valuable in speeding the rate of innovation adoption Opinion leaders tend to have wider and more diverse communication networks, and tend to participate more in those networks. Opinion leaders also tend to uphold the norms of the social group; if the group places value on change, the opinion leader may be very innovative However, when the norms resist change, so will the opinion leader This is where the assistance of an opinion leader is most valuable If the opinion leader is persuaded to adopt the innovation, it sends a powerful message to others that the innovation must be very beneficial, and diffusion can be significantly improved. This is the same principle behind the common stories of the manager who selects the most resistant union members for a committee to consider an innovation. If *these* individuals become proponents of the change, acceptance by others is almost assured This strategy in promoting P2 may be particularly valuable in industries where resistance

to innovation is high Efforts to identify and "convert" opinion leaders should reduce resistance throughout the industry.

Current P2 promotion programs have cast the government in the role of opinion leader **Government agencies or programs generally make poor opinion leaders** This is because they are very different from the people or organizations they intend to influence, and are not part of the social or business network This fact may be difficult for agency personnel to accept. Their initial contacts with businesses may have been very rewarding and promising However, these businesses were almost certainly *innovators*, who were comfortable communicating with those outside their usual network, yet held no opinion leadership.

Overt involvement of a government agency in promotion programs may be more of an impediment than an aid to diffusion. In successful marketing campaigns, an agency may only have contact with the opinion leaders, and then assist opinion leaders in communicating with others in their network. For example, companies may form P2 self-help networks (Reibstein, et al 1994). Effective diffusion requires that government personnel understand the limits of their influence, and use knowledge of the diffusion process to carry the innovation beyond these limits

3.5 CONCLUSIONS

To date, government P2 promotion programs have effectively reached the "low hanging fruit" - the *innovators*. However, Diffusion of Innovation tells us that in the absence of a thoughtfully constructed marketing strategy, further diffusion of P2 will continue to be slow despite the commitment of government time and resources. Lessons from Diffusion of Innovations and other marketing experience offer limitless opportunities for improving diffusion of P2.

CHAPTER 4

THE FABRICATED METAL PARTS INDUSTRY

Our findings as regards technology transfer mechanisms and barriers to the transfer of P2 technologies in the Metal Parts Fabricating (MPF) industry are organized into the following eight sections

4.1 CONDITIONS IN THE MPF INDUSTRY FAVOR P2 ADOPTION

The Metal Parts Fabricating industry is experiencing strong demand for its products, primarily due to strength in the automotive, automotive parts, appliance, and machinery sectors of the economy (Purchasing 1994). This demand is expected to continue through 1995, and the long-term outlook is positive Increased international supply of metal and more efficient metals production processes has produced greater competition among metal suppliers and very favorable conditions for MPFs. Many major manufacturers are seeking increased quality and efficiency from their MPF suppliers, resulting in considerable pressure for innovation and improvement. New technologies which improve productivity and profitability, such as computer numeric controlled (CNC) machines, have widely diffused through the industry in the last decade

The ready availability of P2 technologies that are effective, profitable and affordable for nearly all small MPF companies (USEPA 1990) was confirmed through communications with federal and state P2 assistance personnel. Nearly all small MPFs should be able to realize at least an annual return of $5,000-$10,000 for a P2 investment with a payback period of under two years A large percentage of firms would realize much greater returns In addition, states have given considerable attention, time, and resources to promoting P2 in the MPF industry

Given these factors, one would expect P2 technology to diffuse rapidly through the MPF industry However, federal and state personnel agree that P2 adoption in business, including small MPF companies, has only "scratched the surface".

4.2 MPF MANAGERS ARE OVERWHELMED

MPF managers work long hours, have a very wide variety of responsibilities, and are extremely frustrated with what they believe is ineffective and uncaring government regulation and bureaucracy Most small MPFs have fewer than 50 employees In these small shops there is little room for specialization, and the general manager is responsible for all aspects of the business The responsibilities may include product design, production, marketing, hiring, training, and

regulatory compliance Regulations pertain to hiring and managing employees, retirement, worker health and safety, environmental protection, and many other aspects of the business Most managers are simply overwhelmed. They are able to be proactive in only a few aspects of the business, such as production or product design, and must simply react to problems in other areas of the business as they arise (National Research Council 1993). As one contact in a manufacturing assistance organization put it, small business managers operate "at the bottom of Maslow's Hierarchy. they are just worried about survival." Most managers we spoke to said they could not start a new business in today's business climate, and have advised their own children to pursue other careers

MPF managers we spoke with agreed that nearly all the MPF managers they know want to "do the right thing" The metal supplier we spoke with also indicated that only a small minority of firms would not care that they were generating pollution Yet all agreed that very few firms are proactive in controlling or preventing pollution. Regulatory compliance is generally the driving force behind pollution reduction activities, yet many firms do not know what regulations apply to them or how to comply with such regulations Pollution prevention may be profitable for nearly all companies, but it is rarely pursued.

4.3 TRUSTED INFORMATION SOURCES INFLUENCE DECISIONS

Information sources with pollution prevention knowledge are not trusted, while those who are trusted have no pollution prevention knowledge In our first on-site interview, the MPF manager repeatedly used the terms "comfort zone" and "danger zone" when referring to external parties with whom he must interact. Those parties in his "comfort zone" were trusted and respected Important decisions were generally made using information obtained from "comfort zone" sources "Danger zone" parties, on the other hand, were to be avoided. The less contact with "danger zone" parties, the better We repeated this metaphor in the interviews with other MPF mangers All agreed that it was a very accurate metaphor for their view of different information sources

Based on our interviews, we have constructed Figure 3. Four information sources occupy the "comfort zone" for most mangers suppliers, customers, competitors, and contracted business associates (their accountant, attorney, etc.) Foremost among these was their relationship with their suppliers. These relationships, particularly with their metal suppliers, are often decades old and very personal (USEPA 1990).

Suppliers are selected on the basis of quality, service, timeliness, and price (though a number of MPFs still buy largely on price). Business tends to be performed person-to-person rather than business-to-business In the MPF industry, the metal suppliers play an important role The MPF industry is very mature and there is little opportunity for suppliers to obtain large numbers of new customers. Instead, growth is most readily available through obtaining more of each customer's business To do this, suppliers are expanding the services available to customers and providing more opportunities for personal interaction with customers Supplier-sponsored

dinners and golf outings are a regular part of business For most significant business decisions, suppliers or supplier-sponsored activities played a major role in obtaining needed information.

Surprisingly, competitors also are valued and trusted sources of information in the MPF industry Most contact among competitors occurs at supplier-provided activities. Communication among competitors is complicated by the need to maintain secrecy in areas of competitive advantage However, the managers we spoke with indicated a surprising amount of information exchanged between competitors Information flowed most freely concerning tangential business issues such as personnel, regulatory compliance, insurance, finance, etc. However, even discussion of new production technologies is sometimes exchanged in general terms

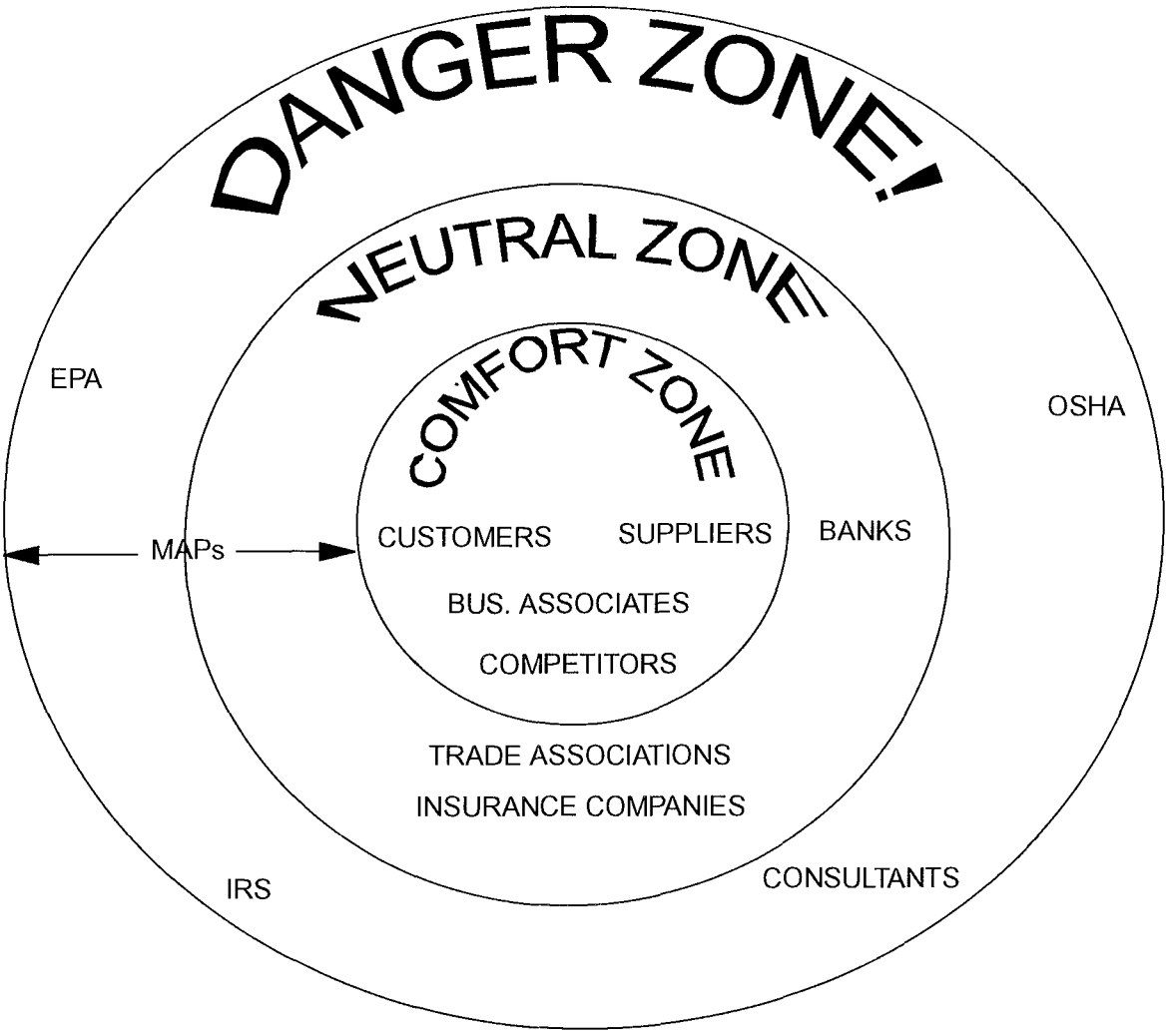
Most small businesses contract some specialty activities, such as accounting, legal, and occasionally, environmental compliance services. These contractual relationships tend to be long-term, personal, and based on a significant amount of trust (since the individual may also be under contract with one or more competitors) MPF managers place great value on the expertise and judgment of these contracted business associates.

The extent to which the MPF manager has a close and trusting relationship with a customer depends, in part, upon the nature of the market Where the company sells to a very small number of customer's, these relationships tend to be long-term and often provide the impetus for innovation. For example, many large companies are seeking closer relationships with their suppliers, but also require continuous improvements in quality and production efficiency. Several managers indicated that these customer-driven changes are a very unpleasant experience Yet one manager indicated, in retrospect, that it was probably one the best things that happened to his business, and to him personally Another manager stated that one of his major customers, a battery manufacturer, was responsible for implementation of P2 practices in his company For businesses marketing to a large number of customers, relationships are likely to be less personal and of shorter duration These customers are less influential in decision-making.

The members of this "comfort zone" play a significant role in an manager's decision to adopt a new idea or technology The support of one of these members will significantly enhance the likelihood that an innovation will be adopted The opposition of one or more member represents a substantial barrier to adoption. The overwhelmed small business manager uses such trusted information sources to be able to sort out valuable ideas from worthless claims (National Research Council 1993).

Parties in the "danger zone" can also have a very pronounced effect on management decisions, but only in a very limited way. All regulatory agencies are in the "danger zone". Managers will go to great lengths to minimize contact with these agencies. However, these agencies have a manager's immediate attention in issues of regulatory non-compliance. Potential enforcement actions can have catastrophic effects for a small company In fact, we were told that some junk mail sources have begun using envelopes closely resembling those of the EPA, knowing that such mail will get priority attention from the manager This dislike of regulatory agencies is generalized to all government entities One telephone interviewee indicated that he

Figure 3. Sources of business information by extent of trust: the manager's perspective.



had a great need for the services offered by the Illinois Hazardous Waste Research and Information Center, but he was so fearful of government that he did not even want to write down the telephone number.

Government agency communications of a nature other that specific issues of non-compliance are unlikely to receive any attention from MPF managers It is difficult to overestimate the extent of government distrust and dislike among small business managers. As one interviewee stated it "the government could be handing out pollution prevention advice on $5 bills and we would assume they're counterfeit " Managers of small MPFs operate on "trust and common sense", in the words of one manager. Because the government is considered unpredictable ("untrustworthy") and has no "common sense" it operates in a fashion counter (and threatening) to business All contact with the government is considered very dangerous Contact is unlikely to be made voluntarily without the prospects of an extremely large payback

Interestingly, consultants were clearly placed in the "danger zone" as well. Though not dangerous in the same way as the government (they may be safely ignored), they are actively avoided most of the time. Consultants were perceived as individuals who profited from government regulations

Between the "comfort" and "danger" zones lies a number of information sources which are not close or personal, but may be sufficiently trusted to allow limited contact This "neutral zone" contains most trade and professional organizations, trade shows, banks and other financial institutions, and insurance companies. For some companies it will also contain local "public" agencies, such as manufacturing assistance programs, particularly those associated with local schools. The make-up of this neutral zone seems to vary from company to company For example, a Chicago area screw machining company manager placed the local trade association on the edges of his "comfort zone" and relied upon it as a regular and valued source of business information Sheet metal fabricators in Central Illinois, on the other hand, had little to do with their professional association and only occasionally obtained business information from this source Some MPF managers placed banks and insurance companies in their "danger zone", though most considered these parties "neutral".

The obvious dilemma raised by Figure 3 is that those with P2 expertise (the government and consultants) are not trusted by small MPFs, while those who are trusted have no P2 expertise. The only solutions are to either move government agencies closer to the "comfort zone" (a valuable, but long-term strategy), or to provide those in the "comfort zone" with P2 expertise. We discuss both options in some detail in the following chapter

4 4 INNOVATIVENESS MATTERS

The range of innovativeness categories (*innovator, early adopter*, etc) suggested by Diffusion of Innovations research appears to be quite descriptive of small MPFs in Illinois A few companies are truly *innovators*, on the cutting edge of technology One manager we interviewed spoke of a neighboring business which made parts for the aerospace industry. This company had

CNC (computer numeric controlled) technology long before other companies in the area. The manager we interviewed became aware of this technology through the aerospace supplier, but never imagined that it would benefit his company (which makes piping for tractors) Only years later, at the urging of his customer, did the manager adopt CNC.

We consider most of the companies we personally interviewed to be *innovators* or *early adopters*. They were open to change and new technology, they were looking for opportunities to enhance success rather than simply avoid failure, and they were comfortable enough with public organizations to grant us extensive interviews Most had wide communication networks, involving regional competitors whom they met through supplier-provided activities or trade associations, and diverse local business with whom they often socialized.

In our interviews with MPF managers, and particularly in our interview with a Midwest metal supplier, we asked them to characterize the range of small MPFs in terms on innovativeness. Their descriptions agreed with those suggested by Diffusion of Innovations. Innovativeness tended to vary with size, on average, with very small shops being most resistant to change and having the smallest communication networks The metal supplier stated they do not market to about half of the small MPFs in their market area because these shops tend to be hard to reach (small and isolated communication networks) and tend to focus on price rather than quality when buying metal. Most interviewees believed that these smaller, isolated shops generate the most waste (per unit of production) but were the most resistant to improvement.

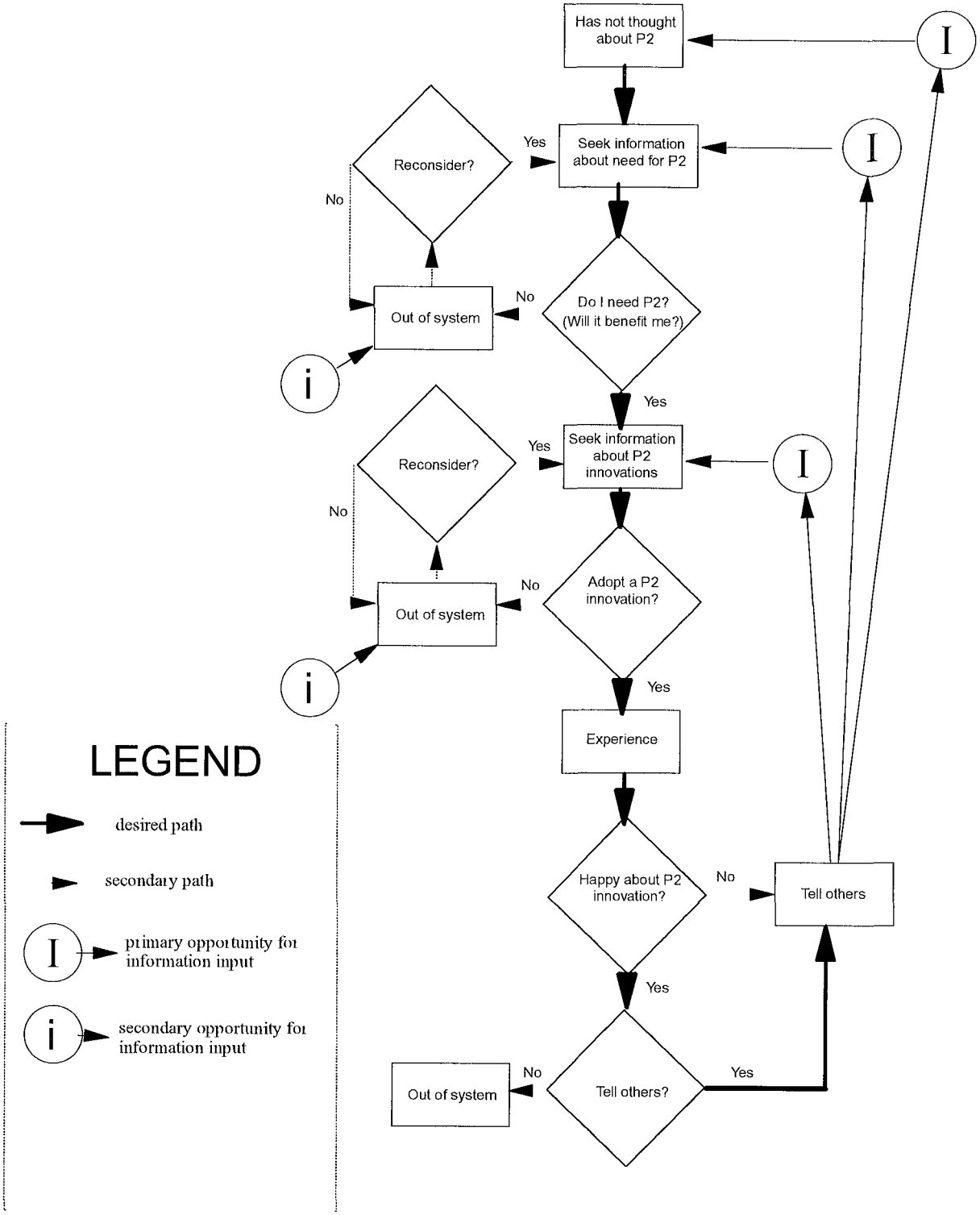
4 5 P2 ADOPTION OCCURS IN STAGES

Based upon the literature reviewed in the previous chapter and the interviews that we conducted, we have developed a model of P2 adoption which we believe applies to a majority of businesses (Figure 4) Ideally, a business begins to think about P2 and seeks information about their own need They decide waste minimization does offer significant potential benefits and begin to seek information about P2 applications, which leads to adoption of P2 ideas The business is pleased with the results and tells others Opportunities for information input are greatest in the initial state of ignorance, when seeking information about P2 needs, and when seeking information about P2 technologies

There are many opportunities to lose businesses in this process Businesses may never leave a state of ignorance, may decide the P2 would not benefit them, may decide that no current P2 options should be implemented, or may be dissatisfied with the outcome of an implemented P2 technology It will be difficult to bring such "lost" business back into the system As in the adoption of most products and ideas, the system is far more sensitive to negative feedback than to positive feedback, that is, decision-makers are likely to be more influenced by information telling them not to adopt, than by information telling them to adopt. This requires careful management of the system to minimize negative experiences by businesses, and to maximize the exchange of positive information.

The findings below are presented as they relate to specific aspects of the adoption model

Figure 4. Decision paths for adoption of P2



4.6 THINKING ABOUT P2 - IT TAKES THE RIGHT COMMUNICATION FROM THE RIGHT SOURCES

We estimate that a significant number of all small MPFs, probably a majority, have not thought seriously about their need for P2. It is not that they have not been exposed to communications about P2, but rather such communications used ineffective language, channels, and sources.

The less innovative managers we spoke with tended to perceive "environmental problems" as synonymous with "legal problems" As long as there we no current or impending legal actions, there were no "problems" Several managers noted that they pay their waste haulers well to make sure there are no problems No one characterized the generation of pollution itself as a "drain on company resources" This way of thinking is a consequence of the overwhelming nature of most manager's jobs, they can be proactive in only a few of their wide-ranging responsibilities Terms such as "pollution", "hazardous waste", or "environment" are immediately related to their definition of "environmental problems", which they have "solved" (meaning no impending legal problems). Managers have no time to devote to problems which are already "solved" The need to change the language of P2 was echoed by many of our contacts in manufacturing and P2 assistance organizations. (Note, however, that when a business is faced with an imminent legal problem, they may be open to traditional P2 language)

The top priority problems for most managers are reducing costs, improving quality, hiring and developing qualified workers, and minimizing regulatory burdens. Two of these, reducing costs and regulatory burdens, are attributes of P2 which may be effective communication alternatives to its "pollution reduction" attributes. However, this will require more than simply pointing out these attributes of P2. It will require abandoning terms such as "pollution prevention" in favor of terms that will key the manager into cost reduction or regulatory reduction thinking at the instant the manager hears them.

Another reason why communication about P2 fails is that it comes from the wrong source and through the wrong channels. As noted above, small business managers (*except for innovators*) do not trust, and wish to minimize contact with, government agencies, no matter what the agency's mission or intent. Communications from such agencies on topics other than specific non-compliance issues are quickly set aside A channel used for much P2 solicitation, direct mail, is the same channel used by consultants and an enormous number of unsolicited vendors, all of whom are actively avoided. Direct mail, and terms such as "free" and "consulting services" announce to the small business manager "don't trust me". Presentations at trade or professional association meetings can be an improvement, since the association itself offers a trusted channel of communication. A largely untapped channel of communication is supplier-sponsored events. Speaking to small business managers at a supplier-provided dinner or outing transfers some of the enormous trust of the supplier to the presenter These types of opportunities are likely to be available only after an agency is able to earn the trust of the supplier

An even more promising, yet largely unexplored opportunity is have members of the "comfort zone" serve as information sources Some suppliers may find that P2 services fit well with their overall marketing strategies Contracted accountants, attorney, or engineers may also find that helping clients find P2 opportunities provides them a competitive advantage and increases demand for their own services. Opportunities should be found to have companies with positive P2 experiences share these experiences with competitors and other businesses. (Further use of "comfort zone" members is discussed in more detail in the next chapter)

4 7 SEEING THE NEED FOR P2 - MPF MANAGERS ARE IGNORANT OF WASTE COSTS

The most obvious benefits of P2 are economic. Yet these benefits are nearly invisible to most MPF managers. This is because their materials accounting and cost accounting systems do not provide information on the true magnitude or costs of wastes For the MPF managers we interviewed, their perception of the waste costs were limited largely to the bill for hazardous waste disposal One MPF with $5 million in annual sales noted that he didn't even know how much scrap metal he produced, and how much of the scrap was defective product Managers apparently are aware of only a small fraction of the waste they generate and the financial impact of that waste on the firm. With this gross underestimate of waste cost, it is not surprising that P2 benefits appear quite small.

This problem is due in part to the overwhelming nature of the manager's job There is nothing acute about the difficulties arising from poor accounting The manager's attention is drawn to more pressing problems Changes in cost accounting practices for small businesses, such as the application of activity-based costing, would dramatically increase the perceived benefits of P2. In addition, such information would be coming through a trusted source, the company accountant. These opportunities will be further discussed in the following chapter

Other reasons why small business managers conclude that they do not need P2 are similar to the reasons why they do not consider P2 in the first place· they fail to recognize the variety of P2 benefits (including a reduction in regulatory burden) and information comes from sources and channels which are not trusted. One-on-one communication is also more important at this point (seeing the personal benefits of P2) than in convincing companies to initially think about P2 (Figure 4) Information must address the specific needs of the business. This is difficult to do through one-to-many channels such as conference presentations

4 8 ADOPTING A P2 INNOVATION - THE RISKS ARE TOO HIGH

P2 is usually too complicated for a small company to do on its own, and too risky to rely on unfamiliar or untrusted sources of information Once a business decides that P2 is needed, it must identify P2 alternatives, evaluate them, select the optimal alternative, implement it, and maintain it Even for relatively simple P2 ideas, this is likely to be beyond the time and expertise available in a small business Changes in production processes or process inputs involves considerable risk to product quality, profitability, and production schedule. Some P2 options may

involve significant expense. Many managers we interviewed stated that they knew areas in which P2 could be profitable, but they simply didn't have the ability to sort out the problem on their own, or to identify an option that would really work In adopting other technologies, these managers typically looked for companies who could provide guarantees, extensive after sale service, and would provide support well into the future.

Few small business managers will make P2 investments without reducing the risks involved. Risks can be reduced largely through three means: 1) obtaining information from trusted sources on the likely effects of a proposed innovation, 2) obtaining such information through low-risk experiences with the proposed innovation, or 3) sharing the risk of the innovation with others.

As we have discussed previously, trusted information sources are those within the manager's "comfort zone". Suppliers, in particular, are well positioned to work with a company on identifying P2 options, and evaluating the likely consequences of each option For MPFs, the most promising suppliers are the metal suppliers, the chemical suppliers, and the suppliers of waste management services. Several managers commented that they would be willing to "pay premium prices" for chemicals from suppliers offering pollution prevention and pollution control services along with their product This is discussed in greater detail in the following chapter. Competitors or other businesses having experience with the P2 technology can also be valuable sources of information.

The ability to experience the technology on a low risk basis is also a useful way to reduce uncertainty. This is the reason for the popularity of "solvent expos", where companies can bring their parts to be test-cleaned by various vendors. One manager who used the services of HWRIC noted the value that those services played in reducing the risk of the new technology.

Risks can also be shared with others Satisfaction guarantees are common with many products today It is a way of binding the interests of the supplier and the customer. New contractual arrangements with suppliers, such as those between GM and some of its chemical suppliers, offer great promise of decreasing waste and chemical usage through creating financial incentives for the chemical supplier (Williams et al 1995). This is discussed in greater detail in the following chapter

Some risks associated with P2 arise from regulatory uncertainty (McDonald et al 1991, Byers 1991). Several managers mentioned that they are unclear how P2 activities would effect their regulatory status, or if they would later be penalized for implementing P2. This regulatory uncertainty may be an impediment to environmental protection, and is one area where communication directly from governmental agencies would be highly valued by small MPFs

A final factor inhibiting P2 adoption is inaccessibility to external financial resources (McDonald et al 1991, National Research Council 1993) Among businesses we interviewed, this was not a barrier. However, when P2 technology costs are high, and company resources are limited, external funding may be necessary The inability of small business to obtain loans for environmental activities, or of certain industries such as dry cleaners and electroplaters to obtain

loans for any purposes, has been reported by others (Pugin 1993) Evidence suggests that the solutions to this problem should focus on freeing up the traditional financing mechanisms, rather than developing parallel financing mechanisms Small business managers will be hesitant to use unfamiliar, and particularly governmental, financing channels

CHAPTER 5

CONCLUSIONS

5.1 CONDITIONS FOR INNOVATION DIFFUSION APPEAR TO BE GOOD, YET P2 DIFFUSION IS VERY LIMITED

Communications with federal and state P2 assistance personnel confirm that P2 technologies are effective, profitable and affordable for nearly all small MPF companies. P2 in the MPF industry has received considerable attention in P2 promotion efforts. Though the MPF industry is mature, it is experiencing strong demand for its products New technologies which improve productivity and profitability, such as computer numeric controlled (CNC) machines, have widely diffused through the industry in the last decade Given these factors, one would expect P2 technology should be diffusing rapidly through the MPF industry.

However, federal and state personnel agree that P2 adoption in business, including small MPF companies, has only "scratched the surface"

5 2 THOUGH MPF MANAGERS ARE DEMANDING OTHER MANUFACTURING INNOVATIONS, THEY ARE NOT DEMANDING P2 INNOVATIONS

This lack of demand for P2 innovations appears to be due to two primary factors. First, those who are promoting P2 are not speaking the language of business. The current language of P2 is perceived by managers to address "environmental problems" These are seen as tangential to their primary concern: productivity and profitability Though P2 addresses these core business concerns, the language currently in use does not establish this connection in the mind of the small MPF manager.

Second, managers greatly underestimate their production waste and the financial impact of that waste on the company Current managerial accounting practices fail to capture the volumes and costs of production wastes. As a result, managers fail to recognize the need to reduce such wastes.

5.3 FAMILIAR TECHNOLOGY TRANSFER MECHANISMS ARE NOT PROMOTING P2

Small MPFs typically adopt new technologies by seeking information from a trusted set of sources. These sources comprise a manager's "comfort zone" of professionally trusted individuals· suppliers, competitors, customers, and contracted businesses associates (accountants, attorney's, etc.) None of these have expertise or business experience in P2. In addition, because P2 is not being demanded by MPF managers, none of these sources is receiving market signals to

pursue P2 expertise Thus, the established technology transfer mechanisms are providing no information on waste minimization.

5 4 GOVERNMENT-DRIVEN P2 TECHNOLOGY TRANSFER MECHANISMS HAVE LIMITED EFFECTIVENESS

Mechanisms established by governmental agencies to promote P2 technology transfer have limited effectiveness because such "artificial" mechanisms are external to the "comfort zone" In fact, government agencies and consultants are in most manager's "danger zone". Managers do not trust members of the "danger zone" and avoid communications from them. Thus, those who are trusted (the "comfort zone") do not have P2 expertise, while those who have the P2 expertise are not trusted by MPF managers

In addition, "marketing" strategies used to promote P2 often use techniques which are inconsistent with the needs and traditions of the business managers they are attempting to reach. Such strategies are ineffective in motivating interest in P2

CHAPTER 6

RECOMMENDATIONS

Our recommendations are divided into 1) General Program Recommendations, applicable to all P2 promotion strategies, 2) Enhancing Traditional Mechanisms for Promoting P2, for improving the traditional direct assistance programs, and 3) Non-traditional Mechanisms for Promoting P2, for agencies wishing to go beyond direct technical assistance

6.1 GENERAL PROGRAM RECOMMENDATIONS

6.1.1 Adopt a marketing viewpoint

To increase the rate of pollution prevention adoption, one must understand the factors governing technology adoption and how to manage those factors If we leave adoption to chance, diffusion is likely to be limited and slow.

6.1.2 Use market research

Marketing programs cannot be successful unless we understand our customers (potential adopters) Market research can be expensive, but ignorance of the customer can be far more costly.

6.1.3 Practice market segmentation

"One-size-fits-all" does not work for a marketing strategy. The needs of early adopters are not the same as the needs of the late majority. Businesses in the early stages of adoption respond to different messages than businesses in the later stages. Multiple marketing programs will be necessary

6.1.4 Use opinion leaders

Opinion leaders, particularly among the *early adopters*, can be identified through marketing research Companies who have led in adopting previous innovations in an industry are good candidates for P2 opinion leaders People, particularly later adopters, tend to trust those who are similar to themselves.

6.1.5 Remember that government agencies are poor opinion leaders

Early contacts between government agencies and *Innovators* are often successful, leading

to the belief that the agency is an effective opinion leader However, agencies are rarely effective opinion leaders with businesses who are not *innovators*

6.1.6 Maximize the use of existing communication channels and sources

Identify the channels and sources used by businesses to adopt other innovations This may include customers, suppliers, competitors, trade shows, trade journals, or trade associations or social events.

6.1.7 Remember that adoption occurs in stages

Different businesses will be at different stages in the adoption process (Figure 2) To be effective, strategies must be directed to the needs of business in each stage.

6.1.8 Remember that in business, competition drives innovation

The need to remain competitive is fundamental The knowledge that competitors are benefiting from P2 may enhance adoption

6.1.9 Seek opportunities to reduce barriers and risks associated with P2 technologies

Better materials- and cost-accounting systems will make the benefits of P2 more apparent and observable by others Innovative approaches to reducing and sharing risks are greatly needed.

6.2 ENHANCING TRADITIONAL P2 PROMOTION MECHANISMS

6.2.1 Improve trust through trusted sources of communication

If government agencies are to provide P2 expertise to small businesses, the best way to reach the small business manager may be through the "comfort zone" members. Suppliers, competitors, and customers may provide the needed introductions to managers

Suppliers represent the greatest opportunity, since they currently introduce their small business customers to valued sources of information. Agency relationships with key suppliers, such as metal suppliers in the MPF industry, must be cultivated. Presentations at supplier sponsored dinners or other supplier-sanctioned events can greatly enhance credibility and effectiveness.

Other trusted sources may also be available. The Illinois Hazardous Waste and Research Information Center is currently developing partnerships with publicly owned treatment works (POTW) Since POTWs are local, and interact regularly with local businesses, they are likely to be more trusted than state or federal agencies. Manufacturing assistance programs, particularly

those established at local community colleges or universities, are also likely to be trusted by more local businesses. Integrating P2 assistance with general manufacturing assistance is a promising opportunity

6.2.2 Change the P2 language

Substitutes for the current P2 language must be found. Terms such as "environment", "pollution", "hazardous waste", and even "waste minimization" should be avoided. The first few words which are read or heard, even the name of an agency or the title of a presentation, can determine whether a manager tunes a message in or out. "Cost reduction", "productivity", "efficiency", and "competitiveness" are more commonly used business terms which are also outcomes of P2 innovations Reducing the regulatory burden is also an important need for small business managers Practical P2 advice which can result in a reduced regulatory burden should be attractive to most small businesses

6 3 NON-TRADITIONAL MECHANISMS FOR PROMOTING P2

One means of dramatically increasing the rate of P2 adoption in small businesses, given fixed budgets for government programs, is to provide P2 assistance indirectly That is, provide P2 assistance to small businesses through other parties This will require non-traditional approaches for assistance programs.

6.3 1 Use the Supplier/MPF relationship

The strategy with the greatest potential increasing the rate of P2 diffusion is the use of the supplier/MPF relationship. Suppliers are the most trusted source of innovation information for most small MPFs. The supplier/MPF relationship is often a long and personal one For some suppliers, P2 may be a logical and profitable extension of their current services

Chemical suppliers are a logical source of assistance, since most pollution problems arise from the use of chemicals and paints in the workplace. A few MPF managers reported close relations with their chemical suppliers However, most managers found their relationships with chemical vendors are not as close as they are with metal suppliers, and the nature of the chemical supply industry makes long-term relationships more difficult In addition chemical suppliers are not perceived as understanding the metal parts fabricating operations Yet several managers indicated that they would pay premium prices for chemical and paint supplies if the supplier provided environmental compliance and pollution prevention services with the product

Some large companies, such as General Motors, have experimented with new contractual relationships with their chemical suppliers (Williams 1995). Chemical suppliers are offered a fixed annual fee, or fee per unit of production, in exchange for the chemicals needed to produce the product, plus environment, health, and safety compliance services. The volume of chemical used per unit of production is expected to decrease during the terms of the contract as the supplier works with the manufacturer to improve chemical use efficiency. Since the fee does not change with reduced chemical use, the supplier finds it profitable to help improve efficiency At the time

of contract renegotiation, the fee for chemical supplies is reduced to reflect the improved efficiency and a new baseline is established. Continuous improvements are expected. This arrangement weds the interests of supplier and manufacturer. The supplier increases revenue and market share not only by obtaining new customers, but by helping existing customers grow so that demand for chemical products and services increase even though chemical use per unit of production declines.

These contractual arrangements maximize the use of existing market power to drive innovation, and offer the best opportunity for rapidly increasing the rate of P2 adoption Direct involvement of P2 assistance agencies is needed to 1) develop contractual arrangements appropriate to a wider array of manufacturers, including small MPFs, 2) promote the use of these arrangements between manufacturers and suppliers, and 3) assist suppliers in the development and dissemination of new P2 technologies

Though chemical suppliers are the most logical supplier to provide P2 services, other suppliers may be equally or better positioned to profit from such services In the MPF industry, no supplier is more trusted than the metal supplier. Metal suppliers generally know the MPF business better than other suppliers and their advise is more valued. Metal suppliers have experienced a strong trend toward metal "service centers" who increasingly compete for business by enhancing and expanding services. In addition, service centers have extensive and experienced sales staff who work regularly with a large number of small business customers The service center we interviewed had over 13,000 customers in the Midwest, most of whom were small MPFs Sales staff know the business managers personally and understand their needs These factors make environmental compliance and pollution prevention services a potentially profitable addition for metal service centers, and an effective way to reach a large number of small businesses through a trusted communication source

The primary barrier identified by the metal service center we interviewed was the additional expertise that would be required for sales staff. It was noted that it took many years to prepare a salesperson just to sell steel. Selling pollution prevention services would require much more. A possible solution to this problem is partnerships between metal service centers and consulting firms Service center sales staff could identify customers needs and pollution prevention opportunities, and consultant staff would follow-up with direct services. Since no marketing time or resources are spent by the consultant, a substantial reduction in fees may be possible. P2 assistance program staff are needed to create and monitor such partnerships.

Another supplier with the opportunity to provide P2 services is the waste management services supplier. Many of the managers we interviewed used the same, national waste management firm This company provided cleaning solvents, solvent management systems, and waste hauling The managers expressed a great deal of trust in this company. When asked if they would welcome an expansion of such services to include pollution prevention, they responded positively Though there is an obvious conflict of interest for a waste management company to help reduce waste generation, the conflict is not greater than that with chemical suppliers The same innovative contractual arrangements that have been successfully used with chemical suppliers may be applicable to waste management companies

6.3.2 Use the Accountant/MPF relationship

One of the most significant barriers to P2 adoption is the underestimation of waste volumes and costs. Underestimates occur because information available to the managers includes little or no information on wastes. The responsibility for providing useful management information lies, in part, with the accounting function in a business. For small businesses, this function is typically carried out by a part-time, contracted accountant. Accountants adhere to accounting standards developed by their profession. In the case of financial accounting (documentation of financial position of the firm) these standards can be rigid However, in managerial accounting, standards are much more flexible, and accounting systems may be tailored to the needs of the firm. This is because managerial accounting systems are intended only for internal decision-making purposes. The purpose of a managerial accounting system is to provide information to managers on the costs and revenues from production, so that decisions can be made which will maximize the long-term financial health of the company Current managerial accounting systems fail to provide accurate information on waste volumes and costs.

Ideally, managerial accounting systems should be able to identify 1) the volumes and types of wastes produced at each operation in a manufacturing process, and 2) the costs of those wastes, including a) disposal costs, b) lost materials costs, and c) lost value-added Activity-based costing (ABC) is a relatively new managerial accounting method to relate the costs of producing a product to each production operation.

The capital budgeting process in companies can also bias decisions against P2 The limitations of current practices and the reasons why these practices often underestimate the value of P2 innovations has been discussed by others (White et al 1993) Though contracted accountants may not be responsible for providing capital budgeting analyses in small firms, they do offer one of the best opportunities to change such practices, since their opinions are highly valued by management.

Several activities could improve waste accounting. USEPA is currently working with the Institute of Management Accountants and the Institute of Certified Public Accountants to promote ABC and other environmentally-beneficial accounting practices (USEPA 1994) The application of ABC and the development of improved accounting systems should be promoted by state P2 assistance agencies through partnerships with state accounting associations In addition, demonstration projects for the application of ABC in small manufacturers can help spread the use of this technique.

6.3.3 Use relationships among competitors and other local businesses

Small businesses are used to relying on other businesses, including competitors, for assistance and advice in making changes. There may be many opportunities for promoting the exchange of P2 information among these businesses

State P2 assistance agencies must promote companies with P2 success stories, and assist with establishing contacts between these companies and others. Opportunities for contacts are limitless, and agencies should be creative Examples include speaking at trade conferences, speaking at supplier-sponsored activities, and hosting on-site visits

Experienced companies may also be able to provide direct assistance to other companies, particularly with the application of a new or unique technology. The industry self-help network established in Massachusetts is an example of innovative ways for companies to share their expertise (Reibstein, et al 1994

6.3.4 Use the Customer/MPF relationship

Some large manufactures have required their suppliers to implement quality improvement and cost reduction programs In return, many of these suppliers become sole, or selected suppliers, and may receive assistancefrom thier customers in quality and production improvement. A similar model could be used for environmental performance While not directly linked to the interests of the customer, the improved environmental performance of the supplier can lead to lower costs and greater financial security The best targets for this type of P2 promotion strategy are large manufacturers who have demonstrated exceptional progress in P2.

6.3.5 Expand availability of capital

As companies progress through the stages of adopting P2 innovations, they some will eventually require external funding. Such funding may not be available to some businesses because lending institutions may be attempting to minimize risk by avoiding certain types of businesses or business activities In response to allegations that lending institutions avoid financing "environmental activities", including pollution prevention, or avoid lending to selected industries, such as dry cleaners and electroplaters, USEPA has begun a banking outreach program (Pugin 1993). The project is intended to identify sources of misunderstanding in the banking industry and provide education on the value of pollution prevention investments This type of outreach program at the state level has the potential to significantly enhance the availability of funding for P2 in small businesses

REFERENCES

Berrigan, J., and Finkbeiner, C. 1992. *Segmentation Marketing: New Methods for Capturing Business Markets* New York, NY, HarperCollins

Byers, R.L 1991, "Regulatory Barriers to Pollution Prevention· A Position Paper of the Implementation Council of the American Institute for Pollution Prevention." J Air & Waste Management Association. 41 (4) 418-422

Kalavapudi, M 1995 "Pollution Prevention Incentives, Barriers, Regulations, and State Programs" IN Freeman, H M ed. *Industrial Pollution Prevention Handbook.* New York, NY, McGraw-Hill, Inc (pp85-98).

McDonald, K , Moss, P., Pelley, J., Smith, B 1991 *Report on Barriers to Pollution Prevention* Minnesota Office of Waste Management.

National Research Council, 1993 *Learning to Change: Opportunities to Improve the Performance of Smaller Manufactures* Washington, D C., National Academy Press

Pugin, C.M. 1993. *Pollution Prevention Financing: The Banking Outreach Project.* Philadelphia, USEPA Region III

"Steel Distributors Record Remarkable Year", 1994 *Purchasing*, October 6

Reibstein, R , Barakatt, C , Frantz, G 1994. "How Companies in the Marrimack Valley Built a P2 Self-help Network", *Pollution Prevention Review*, (Spring)·165-168

Rogers, E.M. 1983. *Diffusion of Innovations.* New York, NY, The Free Press,

US Bureau of the Census, 1990 *County Business Patterns, 1990, Illinois.* Washington, D.C , Department of Commerce.

USEPA, 1990. *Guides to Pollution Prevention: The Fabricated Metal Products Industry.* Cincinnati, OH, Risk Reduction Engineering Laboratory.

USEPA 1994 "EPA & EPA supported activities complementing the action agenda" in Design for the Environment,, EPA 742-K-94-001 USEPA, Washington, D C , July, 1994

Weinstein, N 1988. "The Precaution Adoption Process", *Health Psychology*, 7.355-386

Williams, T A., Brewer, S.S , Mishra, P.N , Underwood, O W 1995 "Pollution Prevention at General Motors", IN· Freeman, H M. ed. *Industrial Pollution Prevention Handbook* New York, NY, McGraw-Hill, Inc.

White, A L , Becker, M , Savage, D.E. 1993. "Environmentally Smart Accounting Using Total Cost Assessment to Advance Pollution Prevention," *Pollution Prevention Review*, 3·247-260.