

CHAPTER 4: ACCOUNTING FOR POLLUTION PREVENTION SUCCESS: A QUANTIFICATION OF NEBRASKA TECHNICAL ASSISTANCE BENEFITS AND COMPARISON TO OTHER PROGRAMS

4.1. INTRODUCTION

There is a need for pollution prevention (P2) technical assistance providers to quantify the success of their projects. Evaluating savings metrics (e.g., monetary savings, solid waste reduction) is a common way to determine how successful projects were. Metrics can then be used to better understand the benefits of the assistance that is offered. Metrics also can be used to compare program results with those published by other P2 service providers. This comparison can give context to how the P2 program's assistance impacts P2 activity on a larger scale.

Since 1997, the University of Nebraska – Lincoln's (UNL) has offered P2 technical assistance to businesses in the state of Nebraska through the Partners in Pollution Prevention (P3) program. The P3 program uses student interns to assist businesses by conducting assessments of waste streams and then developing suggestions to minimize waste generation. To meet the needs of different clients, the P3 program offers three assistance modes. The modes offer technical assistance projects of varying complexities and depths.

After five years of providing technical assistance, the P3 program began conducting studies to determine its state-wide impact. In 2001, the program surveyed previous clients (Chapter 3). Data from surveys were limited because surveys did not

allow for any quantification of cost savings and waste reduction. Survey data also could not provide information on why suggestions were or were not implemented.

To address the limitations of surveys, the P3 program conducted in-depth reassessment interviews of previous clients. This study first identifies and quantifies the advantages of each of the P3 programs three assistance modes. Next, the reassessment data is compared to results published by other P2 service providers.

4.2. P3 TECHNICAL ASSISTANCE

Summer P2 technical assistance was provided to 305 businesses and industries throughout Nebraska. Between seven and seventeen interns (depending on funding) from six engineering majors and eight universities participated in the program each summer. The interns complete two weeks of training on P2 assistance methods before spending nine weeks with clients providing assistance. Typically, the businesses participating in the program have limited experience with P2; consequently, involvement with the P3 program increases P2 activity at a company.

The P3 program is unique in that it offers three modes of assistance to better meet various project and client needs. The three technical assistance modes that are offered include small business, industrial assistance and industrial placement. The small business mode is the least in-depth while industrial placement is the most. Table 4.1 summarizes distinctive characteristics of the modes, based on data from in-depth reassessment interviews of 75 past clients.

Table 4.1. Client Characteristics of Three P3 Assistance Modes. (Percentages are the number of clients of that type per assistance mode as determined from 75 reassessment interviews)

Assistance Mode	Staff Available to Address Waste Management Issues	Typical Business Sector for Clients	Intern's Office Location	Average Projects Per One Student's Summer
Small Business	None (85%)	Service (73%)	Cooperative Extension Offices	5.3
Industrial Assistance	Some Staff (85%)	Manufacturing (85%)	UNL Engineering College	1.8
Industrial Placement	Full-Time Staff (71%)	Manufacturing (71%)	Client's Facility	1.3

Small business projects are often quick assessments (less than two weeks of intern's work) of clients who typically are not familiar with P2. Businesses assisted in this mode tend to be small, with less than a few dozen employees. Because clients in this mode have small organizations, the businesses usually have no staff specifically dedicated to waste management tasks (85% of clients). Instead, the business owners often make all waste management decisions.

Clients participating in this mode are most often service industries (73% of clients) such as dry cleaners and vehicle maintenance shops, although some clients are small manufacturing companies. Clients are found through cold calls or referrals from organization such as UNL Cooperative Extension and the Nebraska Department of Environmental Quality (NDEQ).

The small business assistance mode requires the client to provide relatively little time commitment compared to other modes, and no monetary commitment compared to other modes. Clients are only required to spend a few hours to help the intern become familiar with the businesses' operations. After becoming familiar with the business, interns consult with P3 staff to identify areas in need of P2 improvements. Interns are

provided with daily supervision by P3 staff and work from Cooperative Extension county and district offices.

Industrial assistance, the second mode, offers clients P2 technical assistance with an intermediate level of project depth. These clients tend to be larger than ones participating in the small business mode but tend to have little understanding of P2 before the assistance. Clients participating in the industrial assistance mode often have staff dedicated to waste management tasks, but the staff has other responsibilities at the company (85% of clients). Clients are most often manufacturing companies (85% of clients) rather than service industries. Participating clients are found through referrals and trade organization presentations.

Like the small business mode, industrial assistance requires relatively little time (around five weeks of intern's work) and no monetary commitment from clients. Clients are required to spend a few hours helping the intern become familiar with the businesses' operations. Interns then consult with P3 staff to identify areas in need of P2 improvements. Interns are provided with daily supervision by P3 staff and work from UNL College of Engineering and Technology offices.

Industrial placement, the third mode, provides clients with the most depth of assistance. This mode tends to work with large clients who have a strong interest in promoting P2 at their companies. Clients participating in the industrial placement mode tend to have a full time waste management staff (71% of clients). Clients are of similar size and type (71% of clients are manufacturing companies) as the industrial assistance mode. Participating clients are obtained from referrals and trade organization presentations.

Industrial placements require the most support from clients. Clients are required to provide students with an office at their facilities, day to day supervision, and assistance in identifying areas in need of P2 improvements. In addition, clients participating in the industrial placement mode are required to pay around \$2,000 of the intern's summer stipend. In exchange, the client receives an intern solely dedicated to their waste management issues for the summer. Further description of the P3 program and assistance modes can be found in Dvorak et al. (2003).

4.3. REASSESSMENT METHODS

The P3 program conducted closed-ended surveys of previous clients during the summer of 2001. Closed-ended surveys consist of a series of yes/no questions with no opportunity for a client's written elaboration on the response. Surveys are beneficial in providing a quick and inexpensive method of determining general conclusions on the quality of P2 assistance (e.g., general value of the assistance). Their disadvantage, however, is that these surveys do not provide any quantification of the programs' impact on clients. To address this issue, the P3 program conducted reassessment interviews of past clients during the summers of 2001 to 2004. The program's impact was determined by quantifying the number of suggestions implemented, money saved and the amount of waste reduced.

About 30% of the reassessments were of past P3 clients who had responded to the closed-ended survey and requested a reassessment (Chapter 3). The remaining 70% of the reassessed past clients were randomly selected. Consideration for selection was given to the businesses' location in the state and assistance mode in an effort to keep the proportions reassessed similar to all clients assisted.

On average, reassessments occurred 3 years after the initial assistance (maximum of 6 years and minimum of 1 year). Roughly one-half (52%) of all industrial assistance, 42% of all industrial placement (42%) and 22% of all small business clients that were assisted from 1997 to 2003 were reassessed between 2001 and 2004. Instructions for conducting a reassessment were provided to interns during the two week training session.

Interns were trained to:

1. review the original technical assistance report submitted to the client,
2. visit the client for several hours and discuss the status of each original P2 suggestion; and,
3. obtain the client's description of the actual impact of implementing suggestions.

Clients were asked to consult purchasing orders and waste disposal manifests to accurately quantify savings. If the purchasing and disposal records were not pertinent, the client was asked to estimate an impact with potential savings estimated by the previous intern as a starting number.

Interns then offered to provide additional assistance to the client on new or unresolved P2 issues. The standardized reassessment form interns used is provided in Appendix D.

Based on implemented P2 suggestions, metrics that were determined included (1) dollars saved, (2) kilograms of solid waste diverted from the landfill, (3) liters of hazardous waste eliminated, (4) kilowatt-hour of energy saved and (5) liters of water saved. Energy and water reduction were rarely a major focus of projects; due to the small sample size they are not discussed in this study.

The standardized reassessment forms used by interns provided an opportunity to document any comments on implementation and quantification from conversations with

clients. Particular attention was given to documenting the occurrence of any health, safety, regulatory compliance and prevention benefits because of their difficulty in quantification. The reassessment results were analyzed by assistance mode and compared to impact results published by other P2 programs.

4.4. COMPARISON BY ASSISTANCE MODE

A study of closed-ended survey results indicated that there is a relationship between the assistance mode provided to a client and the clients' perception of the benefits of the assistance (Chapter 3). Reassessment data is used in this study to quantify that relationship by determining average implementation and savings for each mode. In addition, reassessment results from the small business mode were compared in Section 4.5 by the way in which clients were introduced to the P3 program. Clients were introduced to the program by being referred or through cold calls from the P3 interns.

4.4.1. Implementation Rates

There are two ways one can express implementation rates from the data gathered during reassessments. The first is the percent of clients who implement at least one suggestion out of multiple suggestions provided by an intern. The second way is the percentage of suggestions provided to all clients that were implemented. Both rates are calculated using reassessment data and are presented by assistance mode in Table 4.2. Column 2 of Table 4.2 includes the number of clients and students summers expended per each assistance mode.

Table 4.2. Client Reported Implementation Rate, Cost Savings and Waste Reduction by Assistance Mode. (Data in parenthesis for columns 5 – 10 are standard deviations) [Data in brackets for columns 5 – 10 are percent of clients that some savings or reductions]

(1) Assistance Mode	(2) Clients (Total SS ²)	Implementation Rate		Average Annual Savings of Individual Client			Average Savings per Student Summer		
		(3) At Least One Suggestion	(4) Of All Suggestions	(5) Money Saved (\$/Client-yr)	(6) Solid Waste Reduced (kg/Client-yr)	(7) Hazard Waste Reduced (L/Client-yr)	(8) Money Saved (\$/SS-yr) ^a	(9) Solid Waste Reduced (kg/SS-yr) ^a	(10) Hazard Waste Reduced (L/SS-yr) ^a
Industrial Placement	14 (10.9)	100%	56%	11,800 (21,800) [79%]	48,100 (242,000) [64%]	2,600 (1,600) [43%]	15,200 (23,600) [79%]	61,600 (253,000) [64%]	3,100 (1,600) [43%]
Industrial Assistance	13 (7.4)	100%	50%	4,000 (4,700) [62%]	47,300 (292,000) [38%]	620 (450) [23%]	7,000 (19,800) [62%]	82,900 (1,150,000) [38%]	1,100 (2,900) [23%]
Small Business	48 (9.1)	73%	33%	3,500 (12,400) [41%]	19,700 (205,000) [24%]	360 (350) [44%]	18,200 (56,900) [41%]	102,000 (1,230,000) [24%]	1,900 (1,700) [44%]
Total	75 (27.4)	83%	42%	5,100 (14,100) [53%]	29,500 (227,000) [36%]	780 (790) [41%]	14,000 (47,400) [53%]	80,900 (1,090,000) [36%]	2,100 (1,900) [41%]

^aSS (student summers) are nine-week time periods spent assisting client.

The first type of implementation rate, implementation of at least one suggestion, was analyzed by assistance mode and is listed in Column 3 of Table 4.2. All (100%) clients assisted by industrial placement and industrial assistance interns implemented at least one suggestion. Fewer (73%) clients in the small business mode implemented at least one suggestion.

The second way of considering implementation, calculating the percent implemented of all P2 suggestions made, was analyzed by assistance mode and presented in Column 4 of Table 4.2. Clients with industrial placement and industrial assistance interns implemented around one-half (56% and 50% respectively) of the suggestions that were provided in technical assistance reports. Clients with small business interns implemented about one-third of the suggestions.

Despite the methods of expressing implementation rate, clients with industrial placement and industrial assistance interns tended to implement suggestions more often. This trend may be because clients participating in these two modes tend to perceive a greater need for the assistance, and consequently, agree to participate in the more time intensive assistance modes. Agreeing to more intensive assistance indicates a greater initial client interest in implementing interns' suggestions.

4.4.2. Cost Savings and Waste Reduction per Client

Another set of metrics analyzed by reassessments were cost savings, solid waste reduction and hazardous waste reductions as reported by clients. The individual clients' annual monetary savings and waste reductions are averaged by assistance mode in Columns 5 through 7 of Table 4.2, the standard deviations are provided in parenthesis. The percent of clients in each assistance mode with some savings is provided in brackets.

Standard deviation and percent of clients with no savings indicate the wide variation in reassessment results due to conducting assistance projects that address multiple waste media.

Industrial placement projects averaged the greatest savings for all three savings categories (money, solid waste and hazardous waste). Clients with small business interns averaged the least savings of all categories per client. The notably larger per client hazardous waste reductions from clients with industrial placement clients is a result of longer termed projects being more likely to implement hazardous waste reductions. It may be that the industrial placement and industrial assistance modes average the greatest waste reduction per client because both modes tend to work with larger organizations that generate larger quantities of waste.

4.4.3. Cost Savings and Waste Reduction per Assessment Time Input

The cost savings and waste reductions per client may not be fully representative of a program's impact because different amounts of time are spent on different types of assistance (modes). In this study's case, the three assistance modes have much different time inputs; the small business mode averages 5.2 clients per summer compared to the industrial placement average of 1.3 clients. The P3 program normalizes savings data by a 'student summer' to show average cost savings and waste reductions of each mode with consideration to different time inputs (Columns 8 through 10 of Table 4.2). Standard deviations and percent of clients in each assistance mode with some savings presented in Table 4.2 indicate a wide variation in reassessment results due to conducting assistance projects that address multiple waste media.

Data in Table 4.2 show that when normalized by student summer, clients participating in the small business mode averaged similar, if not greater, cost savings and solid waste reduction compared to the other two modes. Normalizing data by student summer is useful in presenting the advantage of providing technical assistance in the small business mode. Although 27% of the clients with small business interns did not implement any suggestions, by working with many clients these interns still produce notable results.

4.4.4. Advantages of Each Assistance Mode

Comparisons of implementation rates and savings metrics identify the unique advantages to each of the assistance modes. Columns 7 and 10 of Table 4.2 indicate that clients with industrial placement interns averaged the greatest hazardous waste reductions while those with industrial assistance and small business interns averaged less. Further analysis of reassessment data shows that clients with industrial placement interns are the most likely to implement a suggestion that reduces hazardous waste generation (61% of suggestions addressing hazardous waste were implemented), followed by industrial assistance (41%) and small business (34%) (Appendix E).

The hazardous waste implementation rate data suggests that the more time-intensive the assistance, the more likely P2 suggestions addressing hazardous waste will be implemented. One reason for this trend is the longer-termed assistance allows the intern time to provide suggestions that are more process and company specific. The intern can, therefore, better recognize and define any associated intangible benefits (e.g., regulatory burden reductions, future liability reductions) at the company. Intangible benefits can provide clients with an added incentive to implement because they can

benefit many different departments within an organization. For example, a process line manager may value a more time efficient process while a president may value avoiding future liabilities. In general, clients participating in the industrial placement mode have larger organizations to benefit from intangible benefits of hazardous waste reduction and are more likely to implement because of those benefit.

To summarize the advantages of each of the P3 program's assistance modes, the industrial placement mode is the type of assistance with the highest implementation rates and per client savings. This success demonstrates that clients who have relatively complex projects, high initial interest in making a P2 change and an interest in addressing hazardous waste issues benefit from the industrial placement mode. The main advantage of this mode is that a client can take advantage of the undivided attention one industrial placement intern can provide for an entire summer.

The industrial assistance mode does not exhibit the greatest savings; however, it has a very high implementation rate and positive savings metrics. This mode is beneficial for clients with discrete, complex projects and a waste management staff that wants to demonstrate the effectiveness of P2 in order to encourage future P2 activity. It is interesting to note that 31% (4) of the reassessed clients with industrial assistance interns reapplied to the program for an industrial placement intern during following summers. This indicates that industrial assistance projects help increase many companies' interests in promoting P2 changes.

On a student summer basis, small business mode averages as large, if not larger monetary savings and solid waste reduction than the other two modes. The advantage of the small business mode is that interns can be exposed to many clients in an attempt to

find those who are most accepting of P2 change. Even if a small business intern works with several clients who do not show significant P2 results, the mode's average impact is notable after a summer.

4.4.5. Comparison of Small Business Results by Method of Introduction

As was concluded in the previous section, one benefit of the small business mode is that interns work with many clients each summer. Generally, these clients are introduced to the P3 program in two ways: (1) referrals, or (2) cold calls. Referrals, the first type of introduction, involve an introduction from an organization that sees a need for P3 assistance at a business and an intern on the client's part for an assessment. Referrals most often came to the P3 program from either NU Cooperative Extension or the Nebraska Department of Environmental Quality (NDEQ).

Slightly less than one-half (42%) of the reassessed small business clients were provided by referrals. To obtain more clients, 'cold calls' were made by P3 interns. Businesses receiving a cold call were less likely to agree to P3 assistance than those who were referred. To increase the success of cold calls, interns relied on leads from NU Cooperative Extension and targeted calls to businesses that may need their expertise.

Reassessment data was used to quantify the advantages of each method of obtaining small business clients. Table 4.3 presents implementation and savings for the two methods, standard deviations are provided in parenthesis. The percent of clients with some savings is provided in brackets. Similar implementation rates were observed for referral or cold-called clients (34% and 32% respectively). Although not statistically significant, possibly due to sample size, referral clients had larger cost savings and waste

reductions per client. A similar trend is noticed if the data are normalized by student summer.

Table 4.3. Quantification by Method to Obtain Clients. (Data in parenthesis standard deviations) [Data in brackets are percent of clients that some savings or reductions]

Method to Obtain Client	Clients (Total Student Summers)	Implementation Rate		Savings per Client		
		At Least One Suggestion	Of All Suggestions	Annual Money Saved (\$/Client)	Annual Solid Waste Reduced (kg/Client)	Annual Hazardous Waste Reduced (L/Client)
Referral	20 (3.8)	70%	32%	4,500 (14,000) [45%]	40,800 (194,000) [30%]	700 (500) [30%]
Cold Call	28 (5.3)	81%	34%	3,100 (11,500) [39%]	20,200 (221,000) [43%]	100 (30) [25%]

To obtain referred clients a P2 technical assistance program is required to spend time and resources networking into the state's environmental community.

The P3 program obtains client referrals as a result of a respected and mutually beneficial relationship between the program, NU Cooperative Extension, NDEQ and many Nebraskan businesses. Reassessment data shows that the reward for building this network is a sizable benefit through reduction in waste and cost savings for referral clients.

Nevertheless, there is benefit to cold calling businesses. Projects from clients obtained through cold calls result in notable savings, as well as similar implementation to referrals. This indicates that there still are many suggestions to be made to businesses that are beneficial and easy to implement (low hanging fruit). In addition, assuming cold call clients may not be as well networked into the environmental community as referral clients; interns can provide valuable education to the business. Finally, cold calls can fill down time when the P2 service provider (in this case, P3 intern) is between referred

assignments. Overall, cold calls do not depend on the time consuming networking infrastructure that develops over years of a program's existence.

4.5. COMPARISON TO OTHER P2 PROGRAMS

There are many P2 organizations that have conducted studies to determine their programs' impacts. For example, Oak Ridge National Laboratories (ORNL) conducted a study in 1999 that focused on the impact of an energy efficiency program (Martin et. al, 1999). The Northeast Waste Management Officials' Association (NEWMOA) published a report in 1998 that detailed P2 progress in 16 states throughout the New England area (Goldberg et al., 1998b). In 2003, the National Pollution Prevention Roundtable (NPPR) published results of an even larger scale impact survey of 63 American P2 organizations (Spektor and Roy, 2003). Quantifying the P3 program's impacts allow a comparison of results.

However, during the past decade there has been no national consensus as to how a program defines or calculates savings metrics. A lack of standardization naturally leads to difficulties in comparing impacts between programs. The absence of standard definitions is a problem that has been well documented by organizations conducting large scale impact studies. In their 1998 report, NEWMOA mentioned difficulties in comparing programs because each used different definitions of a site visit and different units when reporting savings (Goldberg et al., 1998b). This sentiment was echoed in the NPPR's 2003 report (Spektor and Roy, 2003; McComas, 2004).

This use of different definitions of implementation rate illustrates this problem. The P3 program identified two definitions of implementation rate: (1) at least one

suggestion is implemented (83% of all reassessment participants) and (2) percentage of individual suggestions that are implemented (42%).

Another way to modify the implementation rate based on number of suggestions implemented is to not include in the total number of suggestions that are unlikely to be implemented but are provided for the clients' education. An education suggestion is defined as one the client is not expected to implement in the near term, but may be of interest as the client's attitude towards and knowledge of P2 matures. These suggestions include long-term equipment replacement, emerging technology or a P2 direction that may not be economically positive but clients expressed an interest in pursuing. To prevent bias, a retroactive effort was made to identify educational suggestions among reassessment results; the P3 faculty identified educational suggestions without knowing the implementation status of the suggestion. For the P3 program, the percentage of P2 suggestions implemented increased by 7% if educational suggestions were excluded (42% to 49%). Note that implementation rates in Tables 4.2 and 4.3 do not exclude any suggestions.

Efforts are being made to address these definition issues. NEWMOA prepared a guidance document proposing a set of standardized definitions to account for savings and NPPR is currently creating a consistent system for reporting a program's results (Goldberg et al., 1998a, 1998b, 2004). These standardized definitions are not yet widely used. Because accounting definitions tend to vary between programs there is reason to suspect some uncertainty in published impact comparisons. However, a comparison with P3 results is still useful in determining whether the P3 program's impact is of similar magnitude to other programs in the country.

4.5.1. Implementation Rate Comparison

Many studies of P2 program results have published the average rate that suggestions were implemented. NEWMOA reported that the average implementation rate of sixteen P2 programs in the New England area is 44% (Goldberg et al., 1998a). The ORNL, a P2 program placing emphasis on energy efficiency, reports a similar average implementation rate of 44% \pm 4% (Martin et al., 1999). It is unclear whether these programs excluded educational suggestions from their implementation rate calculations. To be conservative, the P3 program did not exclude any suggestions from their calculations of implementation rate. The P3 program averages an overall implementation rate of 42% (Table 4.2) which is of similar magnitude to the NEWMOA and ORNL programs.

4.5.2. Ratio of Client Cost Savings to Cost of Assistance

It is common for P2 technical assistance programs to be supported by grants. The P3 program is supported by grants from the United States Environmental Protection Agency (USEPA), NDEQ and matching funds from UNL. It is therefore, important for P2 organizations to demonstrate the impact of their assistance. One method of demonstrating a program's impact is to calculate the ratio of money saved per funds expended on the program.

To compare P3 impact to other published data, two ratios are calculated. The first is the ratio of savings per grant dollar expended. Grant dollars expended include only the student's stipend and the funding for P3 staff averaged per student. The second ratio is of savings per total funding expended. Total funding expended includes most costs of the program (e.g., cost matching from UNL, cash contributions from clients). Total funding

excludes indirect costs incurred by the P3 program such as office space and in-kind time (salary) contributions from other P3 service providers, clients' staff and UNL extension educators.

Table 4.4 presents the ratio of money saved per funds expended on the P3 program. Research from a U.S. Department of Energy P2 and energy efficiency program indicates a suggestion that has been implemented will be profitable from 4 to 7 years before a client's business grows beyond the benefits provided (Martin et al., 1999). The P3 program conservatively assumes the benefits of an implemented suggestion's will persist for five years. Average student summer savings (Column 8 of Table 4.2) are therefore multiplied by five to determine the total savings per student summer as tabulated in Table 4.4. Savings ratios are then calculated by dividing the total savings per student summer by either the amount of grant funds or the total funding expended.

Table 4.4. Ratio of Client Cost Savings to Cost of Assistance

Assistance Mode	Reassessed Savings / Student Summer	Savings Assuming 5 Years of Savings Persistence	Savings / Grant Funding^a (\$/\$)	Savings / Total Funding^b (\$/\$)
Industrial Placement	15,200	76,000	9.9	8.1
Industrial Assistance	9,600	47,900	6.3	5.1
Small Business	18,200	91,100	12	9.7
All Clients	14,700	73,400	9.6	7.8

^aAverage grant funds per student summer (\$7,660).

^bTotal funds (grant, real dollar matching from UNL and clients, and UNL in-kind matching in form of faculty time) per student summer (\$9,400).

P3 clients participating in the industrial placement and small business modes saw the largest ratio of savings per grant dollar (9.9 and 12 respectively). Clients participating in the industrial assistance mode saw the smallest ratio, \$6.30 saved per grant dollar expended. The dollars saved per total funding expended show the same relationship but are on average \$1.70 smaller than the savings per grant dollar. These

savings ratios are conservative because the average monetary savings does not include any intangible benefits (e.g. improved corporate image) or suggestions that clients did not quantify (e.g., suggestions with only safety benefits).

NPPR gathered data on both savings and funding from 63 P2 programs to calculate a national average savings ratio (Spektor and Roy, 2003). According to a NPPR press release (2003), every dollar spent on state and local technical assistance programs averages \$6.00 of savings to businesses. The data used were from many different programs, so there was not a consistent set of standards when determining program savings (McComas, 2004). The P3 program's ratios of client savings per funding are similar, if not higher than the national average.

4.5.3. Total Monetary Impact of UNL's P3 Program

Average savings per student summer were used to estimate the total savings resulting from the assistance of all 305 clients (86.3 student summers) between 1997 and 2004. 75 clients (27.4 student summers) have been reassessed. The estimation of total monetary impact presented in this section assumes the reassessed assistance projects have similar implementation and monetary savings to those that were not reassessed.

To calculate the total monetary impact of the P3 program, average per student summer savings (Column 8 of Table 4.2) are multiplied by an assumed five-year persistence (Martin et al, 1999). Average per student summer savings were then multiplied by the total number of student summers spent on each assistance mode to determine total savings. The program is estimated to have saved clients \$6.2 million dollars since 1997 (Appendix E).

Considering the program has worked with 305 clients since 1997, each client is estimated to average a savings around \$20,000. The total savings estimates are likely to be conservative. Savings are conservative because clients were hesitant to quantify savings from many suggestions and the calculation does not include intangible benefits (e.g., long term benefits of P2 education to clients and students, staff time saved, future liabilities reduced).

NPPR tabulated yearly savings totals from 27 P2 programs across the country in Appendix II of Spektor and Roy (2003). Total savings in the NPPR report were divided by the number of years a program was in operation and then the number of projects per year. Using this convention, average per client savings ranged from \$900 to \$900,000 (Spektor and Roy, 2003).

It appears that different assumptions were used when programs calculated and reported their average savings. Clients could have reported potential or actual savings; unsubstantiated estimates could have been provided by either the program or the client, and different persistences of savings could have been assumed. Because of the wide range of assumptions that were likely made, it is difficult to compare the P3 program's average per client savings of \$22,000 to a national average. The P3 per client savings are similar in magnitude to those of the Pennsylvania, South Carolina, Kentucky and Iowa's P2 programs (Spektor and Roy, 2003).

4.5. CONCLUSIONS

Reassessment interviews were valuable in allowing the P3 program to quantify and analyze the program's impact internally by identifying advantages of each assistance

mode. Reassessments also allowed for a comparison to other P2 programs. One can conclude the following.

1. Technical assistance involving complex projects, in-depth assistance and clients with an interest in making P2 changes (UNL P3's industrial placement mode) results in the highest rate of implemented suggestions. This type of assistance also results in the largest monetary savings and solid waste reductions per client, and largest hazardous waste reduction per client and per student summer.
2. Technical assistance involving complex projects, moderate-depth assistance and a desire to increase company wide interest in P2 (UNL P3's industrial assistance mode) results in the second highest implementation rate. This type of assistance also results in lower cost savings than the industrial placement mode.
3. Technical assistance involving simple projects, short-term assistance and little existing client knowledge of P2 (UNL P3's small business mode) results in the lowest monetary and solid waste reductions per client. This type of assistance results in similar, if not larger monetary and solid waste savings on a per student summer basis. This type of assistance is advantageous in quickly exposing interns to many clients in an attempt to find the ones most open to P2 changes at their company.
4. Clients that are introduced to the technical assistance provider from a referral have similar implementation rates than those introduced through cold calls. Referred clients, however, average larger monetary savings and waste reductions.

5. Clients in the P3 program implement an average of 42% of the P2 suggestions provided to them. This rate is similar to those calculated by the NEWMOA (44%) and ORNL ($44 \pm 4\%$) (Goldberg et al., 1998a; Martin et al., 1999).
6. An average ratio of client's savings per grant fund expended ranges between \$11.90 (small business) and \$6.30 (industrial assistance). The dollars saved per total funds expended ratios are on average \$1.70 smaller than the savings per grant dollar ratios. The P3 ratios are similar or larger than the \$6.00 national averaged determined by the NPPR (National Pollution Prevention Roundtable Press Release, 2003).
7. Average monetary savings verified through reassessments can be used to estimate total program savings. The P3 program saved clients an estimated \$6.2 million from 1997 to 2004.