Specialty Paint and Coating Waste Prevention Management Project

ENVIRONMENTAL MANAGEMENT CAPSTONE 2016

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EXECUTIVE SUMMARY

The Pacific Northwest Pollution Prevention Research Center (PPRC) and the Environmental Protection Agency (EPA Region 10) partnered with the University of Washington's Program on the Environment to assess supply chain inefficiencies within paint and coating industries. The team's original plan was to conduct interviews in order to (1) identify and quantify sources of waste produced by volume and toxicity measurements, (2) determine the financial impacts of wasted coatings throughout the supply chain, and (3) develop methods to reduce waste production.

Although the team contacted nearly a hundred companies that manufacture or use specialty paints and coatings, requests for interviews went largely unanswered. A data collection and analysis toolkit was developed to help overcome the lack of data. Obtaining accurate, comprehensive, and clearly structured data is essential to determine the true magnitude of paint and coating waste. The toolkit serves to systematize the data collection and analysis process at the company level, promoting for internal improvements. It also serves as a data collection tool so future studies can revisit the teams' original goals.

The team was able to conduct two interviews with companies from the woodworking and aerospace industries. These interviews yielded case studies that show processes that influence paint and coatings waste generation. These data show that between 5-12% of purchased paints and coatings are disposed of without use. Thus, over purchasing resulted in a significant sunk cost. Disposal costs of these products also contributed to lost revenue. Human error while mixing paint batches, product expiration, and the phase out of certain products were all cited as reasons contributing to waste generation.

The team anticipates that future researchers can benefit and learn from their challenges highlighted in this report. We also hope that the tools developed will provide data for future analysis. To increase the sample size of available data, more effective ways to motivate and encourage companies' participation in the data collection process will be necessary. We recommend that PPRC adopt the data collection toolkit as the first step in increasing the amount of available data. The PPRC will also need to fully utilize its professional network and possibly the UW Field Group to encourage company use of the data collection toolkit. After a sufficient number of companies have tracked their unused paint and coatings waste, the PPRC or a future UW student researchers can use the new data to address the initial project goals.

Key Individuals and Team Members

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BETH BRYANT – *COLLEGE OF THE ENVIRONMENT, UNIVERSITY OF WASHINGTON*

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
INTRODUCTION 3
METHODOLOGY 5
Interview Process 5
Toolkit Assembly 5
CASE STUDY ONE: WOODWORKING INDUSTRY 7
CASE STUDY TWO: AEROSPACE INDUSTRY 8
key findings 9
Missing Information and limitations 9
Toolkit Use 11
recommendations 14
APPENDICES 17
Appendix A: Interview Forms 17
Appendix B: Toolkit 20
Appendix C: Promotional Flyer 23

INTRODUCTION

In many manufacturing industries, specialty paints and coatings are applied to the final product to change a basic property or extend the life of the product. Common purposes of these paints and coatings include weatherproofing, adding durability, preventing UV degradation, and adding shine or other aesthetic appeal. The production of these paints and coatings is unique because there are so many different end products; all have unique manufacturing specifications, ingredients, disposal techniques, and shelf-life. Still, all paints and coatings are made by starting from either an oil base or a solvent base. Additional compounds are then added to the base to produce the desired final paint or coating for application. The ingredients of the individual product determine its disposal methods and shelf-life. If a product contains ingredients severely harmful to human health, such as Chromium VI, disposal will be more costly. If a product contains ingredients that break down or separate quickly, then its shelf-life will be much shorter than the average shelf-life, 1-3 years.

Ken Grimm of the Pacific Northwest Pollution Prevention Resource Center (PPRC) has been working with manufacturers who use paints and coatings for many years. His organization targets the reduction of pollution, typically focusing on paint application techniques to do so. While working with manufacturers using paint products across the United States, Mr. Grimm heard many stories indicating potential issues with unused paint waste. According to Mr. Grimm, as much as 80% of specialty paints or coatings purchased by a particular manufacturer can be disposed of unused. Additionally, Mr. Grimm reports that industries have cited reasons that contribute to this phenomenon including a limited amount of shelf space, a short shelf-life, and minimum purchase requirements from paint and coating manufacturers.

After hearing these reports for many years, Mr. Grimm partnered with Carolyn Gangmark from EPA Region 10, to propose a project which attempts to quantify the his anecdotal evidence. Graduate students enrolled in the University of Washington's Environmental Management Certificate Program partnered with Mr. Grimm and Ms. Gangmark to complete this task. Under the management of their faculty mentor, Beth Bryant, the team worked from September 2015 to March 2016.

SPECIALTY PAINTS AND COATINGS

Specialty paints and coatings are used for many purposes. Their defining characteristic is that they are not made for everyday use. So unlike the paint you buy to paint your home's walls, these have protective or decorative purposes. Often, when these products are manufactured they require more toxic, rare, and expensive ingredients to successfully fulfill the purpose for which they were created.

Aerospace manufacturers commonly use specialty paints and coatings that are designed to prevent excessive wear due to extreme environment changes.

Companies that manufacture marine machinery or parts generally use specialty paints or coatings that protect the object from corrosion in the salt water, in addition to many others.

Wood product manufacturers are most interested in protecting their product from normal wear and tear. This means that the specialty paints and coatings used in this industry commonly protect the wood products from water damage, human use, and UV exposure. Aesthetics are also highly valued in this industry.

To do this, students began by developing key goals of the project. The final set of goals for the project include the following:

1. Present case studies of businesses representing four major industries using or manufacturing specialty paints or coatings in the Greater Puget Sound Region. These include aerospace; woodworking; marine; and paint manufacturers.
2. Develop the tools necessary for the PPRC to continue the project. These will allow the PPRC to add to the current sample size, fill in gaps in the data, and better track pollution prevention intervention methods.

These goals were essential in working towards quantifying and analyzing trends in unused specialty paints and coatings in several industries in the Greater Puget Sound Region (GPSR).

Additionally, major goals initially established for this project included further work studying the toxicological and fiscal costs of individual paint products, as well as detailing the exact quantification of unused paint and coatings classified as waste in the GPSR. Due to timing and other circumstances discussed in the *Key Findings* section, the team was unable to make significant progress towards these goals. It is our hope that with the results gathered and the toolkit detailed in Appendix B, a future study may be able to overcome challenges we faced to quantify and analyze paint and coating waste produced by industries in the Greater Puget Sound Region.

METHODOLOGY

Outlined below are the methods developed to achieve the project's goals. In addition to these main goals, the team also completed other major milestones. These included two memos to the client, defining and scoping the original project goals, a midway and final client presentation, a public presentation of the final results, and the development and upkeep of a website detailing our progress (www.sites.google.com/a/uw.edu/paint).

INTERVIEW PROCESS

To begin studying the individual companies and businesses using paint or coatings in the GPSR, the team members constructed an interview outline to survey companies. These documents (Appendix A) include all major scripts, as well as general outlined emails to assure the speed of the interview process. Further, the group and their advisor submitted these documents to the Institutional Review Board (IRB) of the University of Washington. Because the group was only completing a regional case study, the IRB determined that this project was not research, thus an exemption was unnecessary.

Once the outline of the interviews was completed, the group began contacting industry representatives in the GPSR. Mr. Grimm supplied a list of companies he believed would participate. Most companies included did not have an individual employee representative specified as a point of contact. If there was not a point of contact, team members called the front desk of the company and asked for the environmental officer. Over three weeks, the three team members contacted nearly 100 individual companies, some multiple times. Of these companies, only two companies agreed to participate in the survey. . Industry participation was likely low because of a lack of personal connection between the interviewers and the potential representative, a lack of understanding the scope and goals of the project, a general disinterest, and fear of releasing proprietary information.

Team members completed phone interviews with all willing participants. These interviews were conducted via the script found in Appendix A, and answers to questions were recorded on pre-formed data sheets. Some participants supplemented additional information. If team members needed any clarification post-interview, they followed up with the individual via email.

To protect any potential proprietary information, all participants are anonymous in this document and were able to refuse questions in the interview. Additionally, participants had the ability to retract or correct any information given in the interview. Finally, all participants were able to read and approve this report before a final copy was submitted to the clients.

TOOLKIT ASSEMBLY

To best apply the knowledge gleaned from this process, the team felt that developing a set of tools was the best course forward. This toolkit is aimed at assisting future data collection and reducing paint waste. We developed the toolkit to help Mr. Grimm overcome some of the challenges faced in the future. To start, the team assembled a framework that Mr. Grimm could use in the field to assess available data. If

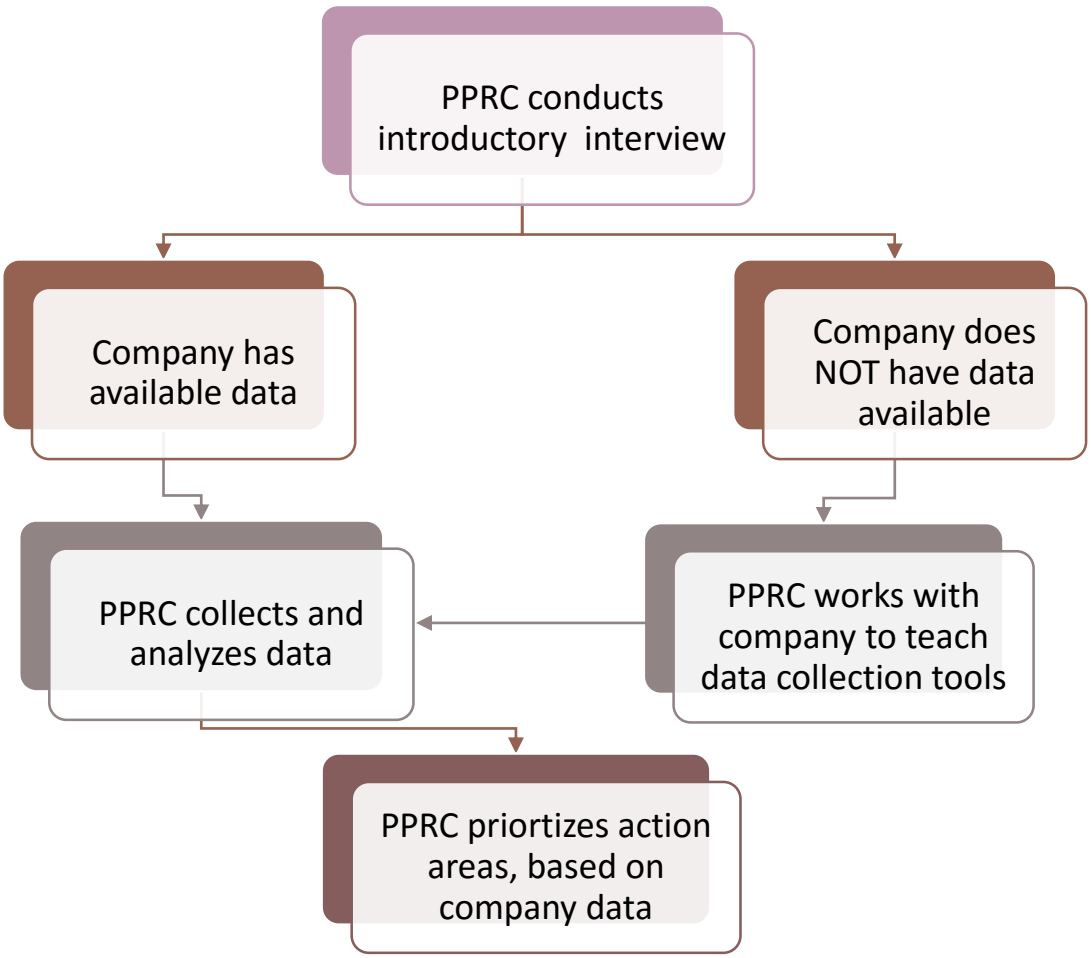


Figure 1: Shows the basic framework used to build the toolbox.

companies have limited data, the toolkit can be used to help record the missing data (Figure 1). As outlined below, this framework first assesses whether or not a company has enough available information for the PPRC to analyze paint waste. If there is enough information, the PPRC would be able to move forward with data organization and analysis (Appendix B). If there is not enough available data, the PPRC would support the company in developing a method to record necessary data and allow the company to conduct basic internal analysis of their supply chain. We believe that this process can facilitate the collection of pertinent information and allow comparison in the region or over time.

Comparing one company's waste generation to another is crucial to identify specific sources of paint waste and quantify industry wide trends. Tracking a company's performance over time is essential for measuring the impact of the paint waste reduction initiative.

Another key aspect of the toolkit is the user's ability to facilitate immediate improvements within a company. Tracking costs associated with specific waste and disposal allows companies to identify areas of improvement, reducing internal waste associated costs and thus waste production. . The team predicts that waste reductions may begin before regional data is compiled and analyzed.

CASE STUDY ONE: WOODWORKING INDUSTRY

An interview with a company that manufactures custom wood ceilings in the Pacific Northwest provided some insights into the challenges of reducing product waste, as well as strategies used to reduce ecological footprints. This interview was conducted in January of 2016 via phone with a current employee.

This wood product manufacturing company largely uses stains and lacquers to achieve an aesthetic finish, rather than improve product performance. The company does not succumb to "brand loyalty" and routinely purchases from a variety of stain and lacquer manufacturers such as Rodda, Sherwin Williams, and Miller. This company did not report any problems with minimum purchase order requirements. Additionally, they typically purchase enough product for shipping costs to be considered inconsequential. In a given year, the company orders 18,220 gallons of stains and lacquers and spends approximately $455,500 for these materials.

On average, the stains and lacquers have a reported one year shelf life before they must be appropriately disposed. Thus, shelf life rarely contributes to the accumulation of waste. However, a major change in products may lead to a significant amount of waste generation. The last time the company phased out particular products they wasted 90 gallons of the leftover stain. Each year the company disposes approximately 2,000 gallons of unused stains and lacquers. If the company only purchased exactly the amount of paint used, they would save approximately $50,000 a year, not including the savings from disposal cost.

By volume, the wasted stains comprise a larger fraction of total waste than wasted lacquers. Most frequently, a stain becomes unusable due to over mixing or improperly mixed batches. In house human error is considered an inevitable reality and large challenge to reducing waste. However, as with most companies, improving performance and efficiency is always desired.

Another challenge of reducing waste is related to their operations. They use a computer system to schedule the product application based on square footage and how much work the coatings department can do in a day. This system may manage time efficiently, but it does not factor in potential wasted paint. In some cases, discarding stains and lacquers could be prevented if two or more orders requiring the same products were scheduled back to back. However, the program may not allow for this because employees are unable to change the system manually.

The company representative suggested waste recycling as a potential avenue for reducing total waste in other facilities. The stain they use primarily consists of acetone, a material that can be reused through acetone recycling and recovery processes. In these processes, the solvent distillation equipment removes the stain and leaves behind usable acetone. This enables the company to reduce the amount of hazardous material that must be disposed.

CASE STUDY TWO: AEROSPACE INDUSTRY

The team interviewed one company in aerospace manufacturing Company in the GPSR. The company primarily builds products for others companies in the aviation industry. It is adept at tracking costs associated with paint waste removal, continually seeking ways to reduce these expenses. They provided some of the most detailed data produced from all of the interviews. Yet due to supply contracts with clients (CMPs), paint management and inventory is more complex within this company than in other companies.

CMPs are arrangements that require the customers to supply the product manufacturer with the paints and coatings necessary. Thus, the manufacturing company does not bear the capital expenses associated with paint and coating purchasing. However, not all products used at this company are included in a CMP. The interviewee approximated that 50-65% of the coatings used in the facility are procured through CMPs. Exact numbers on the volumes of coating procured through CMP and non-CMP work were unavailable at the time of the interview.

The largest expense associated with paint waste removal was air filter disposal. Because this company uses hexavalent chromium in their coatings, these filters are necessary for Occupational Safety and Health Administration (OSHA) regulations to protect worker health in paint booths. Based on company data, approximately 82% of paint and coating waste removal costs at their facility are associated with air filter costs. Air filters used with hexavalent chromium products are hazardous waste and must be discarded accordingly. Few alternatives to hexavalent chromium paints or coatings exist. Further, CMP arrangements may restrict the company from pursuing alternative nontoxic products.

General paint waste represented roughly 12% of the costs associated with waste removal. Of this 12% total cost, the company estimates that up to 45% of it is generated by coating expiration. . However, as up to 65% of coatings used in the facility were supplied by an outside party, the company has little control over the expiration dates of the coatings they receive.

On rare occasion, the company has to dispose unused paints and coatings due to a lack of storage space. This likely represents a very small percentage of total waste produced by the company. The storage space related wastage is driven predominantly by good housekeeping practices.

These data support that roughly 5.5% of the company's total paint waste is due to unused paint generated by inefficiencies in the supply chain. This estimate assumes that hazardous waste expenses are the same for all paint related products. Further, if this 5% waste is uniform for all paints purchased, then for $250,000 of coatings purchased, $13,500 are wasted without use. Unlike the cost of the air filters, or the use of hexavalent chrome, the company may be able to change practices that mitigate this cost.

KEY FINDINGS

Because of the small sample size and low granularity of data, the team produced recommendations and useful data that could help the PPRC conduct more research in the future. Despite not sufficiently analyzing the fully scope of the problem, data from the two case studies presented, presented the following major findings.

- 5% - 12% of purchased paints or coatings are typically discarded without use.
- Unused paint and coatings waste generates a notable expense, although the cost of the excess product and its disposal in relation to overall profits is unknown.
- Each company has its own unique system for managing paints and coatings tailored to their individual needs and processes.
- Unused paint and coating waste was not always distinguished from used paints and coatings or other hazardous waste. This presented difficulties in determining specific disposal costs of unused paints and coatings.
- Reasons for paint and coatings becoming waste varied. Waste creation was related to human error when mixing batches, product expiration, and switching out certain paints and coatings for new products.

Thus, we found that the PPRC may need to use alternative methods, such as the toolkit outlined in this report, to truly assess the scale of the problem. Once this step is complete, solutions that help companies mitigate the cost and amount of waste produced from specialty paints and coatings can be investigated.

MISSING INFORMATION AND LIMITATIONS

Our research into the paint and coatings hazardous waste issue was both limited in quantity and quality of data. Future research may benefit from the insights outlined below.

MANY UNANSWERED PHONE CALLS

The primary limitation that the team faced in this project was industry participation. Though over 100 companies were asked to participate, very few agreed. Team members tried combinations of email and phone contact for all of these companies with little success. Although the exact reasons for companies' unwillingness to participate in an interview are largely unknown, we speculate that it could be related to one or more of the following:

1. The environmental managers do not want to collect the information we were seeking or did not have enough information to participate
2. Essential tasks were considered of higher priority than participating in an interview.
3. , Employees were unsure if participation would be permitted by their superior or the owner of the company.

4. Companies did not think paint and coating waste was a big enough problem to warrant an inquiry.
5. Representatives feared divulging proprietary information. Although the team informed companies that proprietary information would be protected and that the company had the right to retain complete control over the information in the report, the team suspects that these protections many not have been effective in easing companies' concerns. Indeed, there was an individual company who required additional paperwork to protect proprietary information, before ultimately declining to participate.

Some of the companies had no previous knowledge of this project. It is not difficult to believe that without some personal stake in the project, a company had no reason to participate. Further, many of the individuals asked to participate may have not felt as though they could fully answer our interview questions. Commonly, we asked the environmental or health safety officer to work with us. This position allows an employee to interact closely with some of the regulations for worker health when painting, but may not allow an employee to be comfortable discussing overall cost or purchasing operations.

LOW DATA QUALITY

After completing the interviews with the case study companies reviewed here, the team found that many of the records necessary to determine the cost and volume of wasted and unused paints and coatings were not available. Though it is possible that some companies do keep record of this, the case study participants did not have enough detailed data.

First and foremost, the interviewed companies did not keep records that separated unused paint and coating disposal from used paint and coating disposal. Instead, both products are usually mixed together and discarded in one large 55-gallon drum. To quantify the full scope of the problem, companies supply data on individual product disposal, prior to adding it to the general hazardous waste.

Additionally, the data we collected during interviews and surveys was predominantly qualitative. The quantitative data collected were not supported well by the primary data consisting of generalizations, estimates, and approximations. Because of the quality of data, many assumptions about the exact sources of paint waste and financial impacts were reasonable estimates at best. In order to truly quantify the problems faced by the paint and coating supply chain, more detailed data on paint waste sources and reasons for disposal are necessary. Tracking this waste must include information about the product, reason for its disposal, and quantity disposed. If companies begin tracking this information in an organized manner and make it available for analysis, then conducting a substantial review of the data would be feasible.

In some cases, much of the information is already available within the company, but it is simply not organized in a form that allows for evaluation. This problem is exacerbated by the fact that key data points, such as the specific volume or reason for its disposal, are not typically viewed as valuable to operations Therefore, these details are not measured or recorded.

Nonetheless, by conducting a very rudimentary analysis based on the available data, we were still able to generate a rough percentage of unused paint and coating waste in an individual company. For our two case studies this is between 5-12%.

Although this percentage is much lower than the anecdotal evidence suggests, it is important to note that the case studies are not generalizable to other companies. It is also important to recognize that these two companies were the only firms out of the nearly 100 we contacted that agreed to an interview, and the voluntary nature of this study promotes biased results.

TOOLKIT USE

The toolkit developed was intended to help collect data quantifying paint waste and reduce this waste where possible. The application of the tools developed are based on the process discussed above and outlined in Figure 1. The toolkit consists of five specific tools. They are:

1. Promotional Flyer – A promotional flyer was developed to assist the PPRC in spreading the word on its interest in data collection (Appendix C). It focuses on benefits that inventory management can provide a company.
2. Interview Questions – The interview questions are designed to assess if a company is tracking paint and coating waste in sufficient detail for data analysis to be conducted (Appendix A). They also provide qualitative information about challenges in a company's supply chain. These establish of a baseline from which future improvements can be compared.
3. Inventory Record – The inventory record is a simple Excel spreadsheet designed to allow a tracking paint/coating purchases and disposal in an individual company. It has filters established which will allow information consolidation to be applied in the Data Analysis Tool (Appendix B).
4. Data Analysis – The Data Analysis Tool is the primary analysis tool developed from this project. It is designed to be applied by individual companies using information collected about Paint/Coating purchases and disposal. This document should be used to collect and analyze data from companies. The tool is an Excel spreadsheet which takes data on the coating/paint supply stream and calculates the cost associated, volume of waste paint produced, capital investment losses, and waste ratio (Appendix B).
5. Comparative Analysis-The comparative analysis tool is a simple Excel spreadsheet which applies data from the Data Analysis Tool and provides quick comparisons between different data sets. This has powerful applications that include comparing multiple companies, tracking a single company's performance over time, and examining trends in various industries or companies of similar sizes (Appendix B).

The team believes that the professional relationships and technical expertise of the PPRC will enable the organization to much more effectively reach companies and encourage participation in this paint waste reduction initiative. During site visits, members of the PPRC staff can offer their services and support in reducing unnecessary paint waste. If a company consents, the first step in this process is assessing the availability of records.

If a company is able to produce records of paint purchases and volumes of paint disposal (with specific causes of disposal), the PPRC staff can take this data and compile it using the Data Analysis Tool. If not, the PPRC can provide the company with the remaining elements of this toolkit and work with them to develop internal data collection and analysis using the tools provided.

The primary tools developed to assist a company in tracking the flow of coatings during their operations are the Inventory Record and Data Analysis Tool. The Inventory Record is a very basic tool designed to be printed out and placed in the procurement office for the tracking of paint purchases and in the waste disposal section for recording types of coating disposed, volumes, and the reason for disposal.

When enough raw data is collected, the information in the Inventory Record is inputted into the Data Analysis Tool. If the Inventory Records contain more entries than the Data Analysis Tool can support, the filters on the Inventory Record Tool can be used to consolidate the data for entry into the Data Analysis Tool.

The Data Analysis Tool will output the following information for each coating tracked:

1. Volume of waste produced from operations, expiration of paint, storage restrictions, and other sources.
2. The percent of waste produced for that coating from operations, expiration of paint, and storage restrictions.
3. The estimated cost associated with the waste from each source (operations, expiration, storage, and other).
4. Average cost of paint/coating per gallon.
5. The waste ratio of the specific coating.

The Data Analysis Tool will output the following company wide information:

1. Waste Ratio
2. Total volume of coatings wasted with breakdown of volume disposed of from operations, expiration, storage restrictions, and other sources.
3. Average cost of paint/coating per gallon.
4. Estimated loss of capital from paint wastage with breakdown by source of wastage.

Waste Ratio refers to the amount of waste produced per gallon of paint consumed (i.e. a waste ratio of 25% would mean that a quarter of the paint used becomes paint waste). This is believed to be a very important metric of comparison. As waste production in the paint industry is unavoidable, a company that purchases large volumes of paint may be operating very efficiently but producing the same volume of waste as a smaller company that has very poor inventory management practices. Of these two companies there may be more room for improvement in the smaller company despite the fact that it produces an equivalent volume of waste.

To assist companies and the PPRC in prioritizing which coatings in a company demand improvement, the Data Analysis Tool provides a plot of the companies coating management performance for each coating

used. This plot compares the volume of waste produced to the waste ratio. Thus coatings with high waste ratio and high volumes of waste can quickly be identified for further examination.

Basic cost analysis is included in the Data Analysis Tool to highlight the economic impacts of this problem in specific companies. Providing this data upfront for companies may encourage improvement and allow companies to prioritize this issue amongst other operational concerns.

The Data Analysis Tool, once filled out, can be sent to the PPRC for comparative analysis using the Comparative Analysis Tool. This tool compares various companies' waste ratio and volume of waste to each other. The tool also allows for additional types of analysis. As such, may be used both within individual companies and by the PPRC. Some applications of this tool include:

1. Comparing multiple companies in a region to prioritize PPRC support.
2. Comparing companies of similar size or in a specific industry.
3. Tracking waste production for companies over time.
4. Comparing a single type of paint/coating being used by multiple companies.
5. Tracking impacts of operational changes in a company on waste production

Similar to the Data Analysis Tool the Comparative Analysis Tool provides a comparative plot of the information being compared. This allows the user to quickly compare values and assists in decision making related to the allocation of resources for continued improvement.

These tools allow the PPRC to begin an organized attempt at collecting data on paint waste and identifying sources of waste production. These tools are designed to provide the PPRC with enough data to identify trends and establish areas within a region that are in need of additional improvement and research. The tools will promote internal improvements within each company. A metric of comparison enables companies to set goals such as "reducing losses from unused paint waste by 5% over the next quarter" and track if these goals are met.

We believe that if these tools and the research approach outlined above, are applied by companies and the PPRC, there will be immediate improvements in paint/coating management practices. Further, opportunities for future improvement will become much more realistic.

RECOMMENDATIONS

To facilitate future research in this area, the team developed the following recommendations:

1. **Use professional network of PPRC staff to initiate connect with environmental or safety managers to increase participation in interviews and promote toolkit use.**

Graduate school students lack the credibility and industry expertise to draw enough interest from companies. The PPRC has developed a history and professional relationships with industry employees through their painting efficiency program. These relationships provide avenues for mutually beneficial outcomes if adoption of the toolkit. which may act as a catalyst for reduced waste production. To best utilize existing relationships we suggest:

- **Handling each company that adopts the toolkit on a case by case basis.** Although the data gathered from several companies would eventually be used for a region wide analysis, building up the causal relationship between tracking and reducing waste is vitally important. Before the toolkit is scalable to the regional level, companies need some indication that it could work for them. By working with companies individually and directly, there is a greater likelihood of success. Such cases would provide additional marketing avenues for toolkit adoption.

- **Identifying the reasons why companies are reluctant or unwilling to participate in interviews.** On a couple of occasions, companies that expressed interest in participating in an interview with the PPRC ceased correspondence. The PPRC can begin understanding why by reaching out to these companies again and asking them why they changed their minds. Perhaps their answers can be used as an indicator for why so many other companies never responded to our requests. Once explanations for aversion to this project are revealed, strategies to minimize these barriers can be developed.

- **Begin introducing the toolkit into the standard operating procedure of proving technical assistance for pollution prevention.** Meeting face-to-face with the workers who apply paints and coatings during trainings is a great opportunity to attract buy-in from the employees who would actually be responsible for filling in the purchase and waste record. During these trainings, companies are proactively confronting issues of regulatory compliance, health impacts, preventable waste, and environmental liabilities. This provides the ideal setting to present an additional activity that can lead to pollution prevention and cost savings.

- **Attending trade conferences and industry group meetings to build new connections.** In situations where there is no relationship or history between the PPRC and a particular company, it may be difficult to attract support for pollution prevention activities. A PPRC

presence at trade conferences and similar events could signal to industry representatives that their companies can benefit financially from reducing waste. This may subsequently lead to further interaction with the PPRC and adopting their pollution prevention methods including the waste tracking tool.

2. **Using the toolkit outlined above to increase the availability of necessary data, as well as the total sample size of participants to best assess this problem.**

The toolkit was created to help overcome the challenges of data collection. Evidence from the case studies suggests that companies do not track paint purchasing and disposal with clear distinctions between used and unused sources of waste. The toolkit provides a streamlined format to collect, report, and analyze accurate and precise data. To help facilitate adoption of the toolkit and increase participation of surveyed companies we recommend:

- **Developing a toolkit data confidentiality agreement.** During our experience of asking for interviews, the issue of revealing propriety information came up as a deterrent to participating, even despite the assurances that the interviewee could refuse to answer any questions, redact any statements at any time, and remain completely anonymous. Companies may worry that the data given to the PPRC might be made available to their competitors. A confidentiality agreement agreed to and signed by both parties would ease those concerns and increase the credibility of the toolkit.

- **Establishing agreements for the data release schedule.** Clearly articulating the expectations for the toolkit users could provide an accountability mechanism for the PPRC to ensure companies retain the use of the toolkit into the future and provide collected data to the PPRC. Obtaining data overtime from a large sample of companies is crucial to tracking improvement and for the PPRC to conduct regional analysis. By giving companies time-frame options (e.g., every six months, year, or fiscal period) for disclosing their data, the companies can choose an arrangement that works best for them. This in turn encourages participation and provides a steady stream of data to the PPRC.

- **Provide free, quick and accessible trainings for how to use the toolkit.** Just giving companies a data collection product will not likely be enough to induce operational changes. By showing workers and supervisors their roles in contributing to the effectiveness of the tool, they will be more likely to consider filling out the purchasing and waste record as well as the analysis tools fundamental components of the toolkit.

3. **Involve the UW Field Group and a potential graduate student interested in industrial hygiene to maximize number of connections and utilize all potential resources.**

The UW Field Group is collection of UW employees and students working to improve industry worker health. By partnering with them, graduate students may be able lead the charge for conducting a regional analysis of the collected data and development of strategies to reduce paint waste. Additionally, the UW Field Group has already established strong relationships with many companies in the GPSR. Representatives of the UW Field Group may be more successful in encouraging the tracking of paint waste production in these companies.

APPENDICES

APPENDIX A: INTERVIEW FORMS

Introduction

This brief Interview outline provides a guide for conversation that can be followed in assessing availability of data, paint resource management, and waste generation by a company. Its primary goal is to assist members of the PPRC in identifying areas of concern in the paint/coating supply chain and provide appropriate resources for the quantifying and reduction of waste production.

Paint User Questions:

1. Do you keep records of the following:
    a. Paint quantities purchased
    b. Purchase price
    c. Disposal volumes of specific products
    d. Reason for disposal of products

If YES, is this data accessible for data analysis?

If no, provide Inventory Record and Data Analysis for data organization and future tracking.

If NO, encourage the tracking of this information and provide Inventory Record and Data Analysis Tools.

2. What non-latex paint or coating products, or kinds of products, do you most frequently use in your facility?
    a. What do you use these products for?
    b. How much of these products do you use every year?
    c. How much do you spend on paint and/or coating purchasing a year?
    d. On average how much of these paints or coating do you have to dispose of without use due to causes unrelated to paint or coating application?

3. Do restrictions such as minimum purchase or shipping requirements have a role in how much of a paint or coating you purchase? *IF YES, a-d*
    a. Do these requirements require you to order more of a coating or paint than you are capable of using?

b. To what extent do these requirements play a role in making a purchase?

c. Approximately how much waste is generated as a result of this?

d. How much additional expense do you think this costs your company?

4. Do shipping costs play a role in determining how much of a paint or coating you purchase? *IF YES, a-c*

a. To what extent do shipping costs play a role in ordering paint or coatings?

b. Approximately how much waste is generated by this?

c. How much additional expense do you think this costs your company?

5. Does product shelf life play a role in the generation of paint waste in your company? If so, how?

6. Does storage space play a role in the generation of paint waste in your company? If so, how?

7. Is there one product or type of product that you dispose more of by volume?

a. Which product?

b. Approximately how much of it do you dispose and how frequently?

c. What causes the paint or coating to become waste?

8. If any, how much do you spend on hazardous waste removal every year?

a. How much of this is due to paint or coating waste?

9. Are there products that are notably more hazardous of which you frequently dispose?

a. Which product?

b. Approximately how much of it do you dispose of and how frequently?

c. What causes this paint or coating to become waste?

10. Do you see any issues with the supply chain of paint or coating products in your company?

11. In your opinion, do other companies engaged in similar work as yours face the same paint and coating supply and disposal challenges? Do you think that this the case for the region, state or country?

12. Can you suggest any strategies that may help in more effectively managing coating purchasing and use?

APPENDIX B: TOOLKIT

Below is an example of how a company may use the toolkit. The first and second figures shows the inventory record, the third and fourth figures show analyses of the use of paint in this fictional company, and the final figure shows an example of how the PPRC can use this toolkit to compare paint waste data across companies.

Coating/Paint Purchase & Waste Record

Coating/Paint	Volume Purchased	Cost per Gallon	Volume Disposed (Gallons)	Reason for Disposal
Sustainable Stain			60	Expired
Renewable Red Resin			36	Operational
Husky Purple Sealant			23	Storage
Dubbs Primer			20	Expired
Renewable Red Resin			84	Operational
Sustainable Stain	2500	17.56		
Husky Purple Sealant			10	Other
Renewable Red Resin			168	Operational
Husky Purple Sealant			52	Expired

The figure above shows a partially completed Inventory Record. It serves as the primary data collection and organization tool. It also serves to consolidate data entries for input into the Data Analysis tool.

Company Name:	UW Paint & Coatings	Phone Number:	555-1234
Company Point of Contact:	John Doe	POC Email:	Uwpaintwarte@gmail.com

Coatings Used	Initial Inventory (Gal.)	Final Inventory (Gal.)
Renewable Red Resin	2500	3000
Sustainable Stain	800	650
Dubbr Primer	1000	780
Hurky Purple Sealant	0	120

Dates	
Data Collection Start Date:	1/1/2015
Data Collection End Date:	12/31/2015
Data Analysis Conducted:	1/15/2016

Paint/Coating Record

Paint/Coating Name	Volume Ordered (Gallons)	Cost Per Gallon	Volume Disposed (Gallons)	Reason for Disposal (Expired, Operational, Storage, Other)
Hurky Purple Sealant	1200	22.5		
Dubbr Primer	4000	26.5		
Sustainable Stain	2500	15.85		
Renewable Red Resin	1500	31.18		
Dubbr Primer			278	Operational
Sustainable Stain			60	Expired
Renewable Red Resin			36	Operational
Hurky Purple Sealant			23	Storage
Dubbr Primer			20	Expired
Renewable Red Resin			84	Operational
Sustainable Stain	2500	17.56		
Hurky Purple Sealant			10	Other
Renewable Red Resin			168	Operational
Hurky Purple Sealant			52	Expired
Hurky Purple Sealant	1100	26.75		
Renewable Red Resin			70	Storage
Hurky Purple Sealant			65	Operational
Dubbr Primer	4000	24.3		
Dubbr Primer			253	Operational
Hurky Purple Sealant			40	Operational
Renewable Red Resin			57	Other
Dubbr Primer			8	Storage
Hurky Purple Sealant			25	Expired
Hurky Purple Sealant	700	20		
Hurky Purple Sealant			40	Other
Sustainable Stain			35	Operational
Renewable Red Resin	1000	34.28		
Sustainable Stain			5	Operational
Renewable Red Resin			65	Other
Renewable Red Resin	1500	29.75		

Above is the data entry section of the Data Analysis tool. Data gathered and or consolidated with the Inventory Record is put in. The results are given by specific product, as shown below, and in the form of company wide data.

Product Specific Analysis

Renewable Red Resin

Waste Data			
Source	Volume	% Volume Waste	Estimated Cost
Operational	288	60.00%	$9,048.60
Expiration	0	0.00%	$0.00
Storage	70	14.58%	$2,199.31
Other	122	25.42%	$3,833.09
Average Cost Per Gallon:	$31.42	Waste Ratio	12.00%

Sustainable Stain

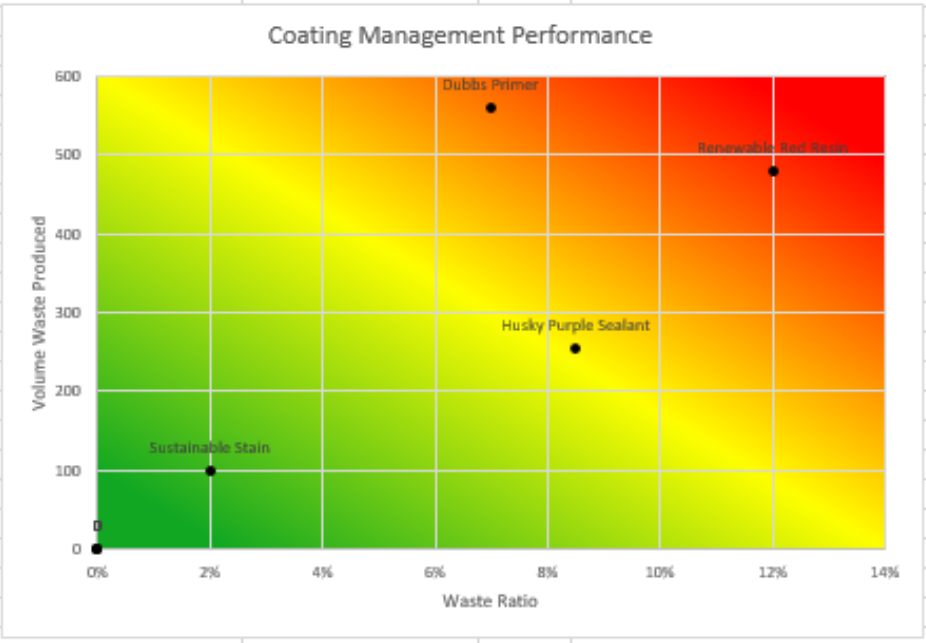
Waste Data			
Source	Volume	% Volume Waste	Estimated Cost
Operational	40	40.00%	$668.20
Expiration	60	60.00%	$1,002.30
Storage	0	0.00%	$0.00
Other	0	0.00%	$0.00
Average Cost Per Gallon:	$16.71	Waste Ratio	2.00%

UW Paint & Coatings

PPRC Data Analysis

Company Wide Volumetric Wastage Averages	
Waste Ratio:	7.0%
Volume Waste from Operations:	964
Volume Waste from Expiration Dates:	157
Volume Waste from Storage:	101
Value Waste from Other:	172
Total Volume Wasted:	1394

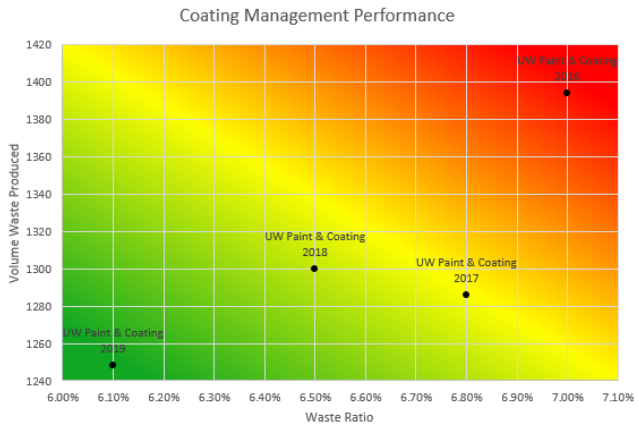
Company Wide Cost Averages	
Average Cost Per Gallon:	$24.14
Estimated Losses from Operations:	$25,669.08
Estimated Losses from Storage	$3,317.88
Estimated Losses from Expiration:	$2,942.44
Estimated Losses from Other Sources:	$5,006.84
Total Estimated Losses:	$36,936.23



Company wide data from the Analysis Tool shown above can be collected over time. One of the applications of the Comparative Analysis Tool is the comparison of changes in a company over time. This can be used to assess impacts of changes in a company's operations or paint management practices.

PPRC Comparitive Analysis

Company Name / Timeframe / Product	Waste Ratio	Total Volume Wasted
UW Paint & Coating 2016	7.00%	1394
UW Paint & Coating 2017	6.80%	1286
UW Paint & Coating 2018	6.50%	1300
UW Paint & Coating 2019	6.10%	1248



APPENDIX C: PROMOTIONAL FLYER

pprc

Tracking Paint Use and Waste

Learning about your company's waste

DID YOU KNOW?

Companies like yours reported wasting up to $50,000 in unused paint costs every year!

Ken Grimm, from the Pacific Northwest PPRC and graduate students from the University of Washinton's Program on the Environment have partnered to help your company. Interested in learning how to best reduce waste associated with unused paints, they have developed the tools necessary for you to begin tracking the information that may help you save money over time.

Why should you do it?

- Identify costs associated with buying paint that is never used
- Find costs associated with disposing unused paints
- Reduce total waste output
- Save money for your business!

For information on how to get started, as well as tools developed to make it easy for you and your company, contact us!

Ken Grimm
206-352-2050
kgrimm@pprc.org