6

A Sustainable Service Program for the Automotive Refinishing Industry

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1. Introduction

The automotive body repair and refinishing industry can be considered a subsystem within the complex automotive system. Daily around the world, this industry generates small amounts of pollutants and for that reason, this pollution is not usually considered in the big picture; however, the total environmental impact of a large number of these small generators might be significant. Occupational risks are other sustainability concerns in this industry, exposure to isocyanates and poor work conditions are often present because a lack of safety and health programs in place.

There have been generated a lot of information about the occupational and environmental practices performed in auto body shops from transnational companies such as Ford, GM, Honda, General Motor, Toyota and others where workers performs in safer occupational and environmental settings, but little had been revealed about sustainability practices in small auto body shops from the developing world until researchers from the University of Sonora and the University of Massachusetts Lowell started a collaborative multi-tiered research in Mexico to fill this gap in the knowledge.

This chapter is aimed at encouraging the implementation of a Sustainable Service Program (SSP) in the small auto body shops that holds the exciting potential of preventing, eliminating and/or reducing the environmental and occupational risks associated to this industry while enhancing and strengthening its economic growth.

Evidently, none can expect the small auto body shops has the financial structure for hiring specialists in implementing strategic projects. Often, small auto body shops lack the resources to maintain formal management programs like those described in handbooks. For that reason, the Sustainable Service Program presented in this chapter has been tailored to being implemented at small and medium sized auto body repair where there is a general dearth of adequate managerial and engineering skills for the implementation of ultimate philosophies, techniques, procedures, and rules such as it is done in larger companies. The program was designing with the idea of helping owners in auto body shops who cannot afford expensive consultant fees, but have the support of a higher education institution, or

other non-profit organization, through a graduate student or an advanced undergraduate student enrolled in a sustainable development program.

Before beginning a detailed description of the specific stages of the Sustainable Service Program, it is important to explore some important aspects of sustainability on this industry.

In 1987, the Brundtland Commission defined Sustainable Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED; 1987). This concept is conceived as a broad structural approach that takes into account economic, social, and environment aspects (Byrch et al., 2007).

Cleaner production and pollution prevention are concepts used to contribute to sustainable development based on a prevention approach that looks for eliminating risks at the sources. Both concepts are found on literature interchangeably because both are grounded on aiming its efforts at the source of the problem. Bass (2005) documented that the United Nation Environment Program (UNEP) exported the term pollution prevention from North America to Europe in the second half of the decade of 80's; yet, it is very usual to find the terms together such as noun "Cleaner Production and Pollution Prevention".

This approach calls for identifying operations and tasks that potentially could pollute the environment or could pose harm to workers, but where it is created "at the source". On the contrary, the goal of control approach is isolate the worker or environment from the hazard and by this mean avoids the potential damage. For that reason, U.S. EPA (2005) prioritizes prevention over control initiatives.

Professor Ken Geisser (2001) proposes dematerialization and detoxification as pathways of clean production to promote a sustainable material system that reduce the risks to environment and workers. These techniques results important in a cleaner pollution and pollution prevention program.

Pollution prevention programs are usually perceived as a planning process to obtain environmental benefits. According to Bishop (2010) a careful planning is required to ensure the success of pollution prevention activities. Two decades ago, the U.S EPA outlined the major steps needed for planning and implementing a pollution prevention program (U.S. EPA; 1992); this outline has been used for implementing such kind of voluntary programs in the United States of America and world-wide.

A critique to pollution prevention programs is their bias to environmental issues paying inadequate attention to social and economic initiatives such as all related to occupational health and safety. Environmental sustainability is necessary, but it is not enough for sustainable development. A sustainable program conceptually differs from a pollution prevention program on its purpose for potentially integrating economic, environmental, and social dimensions, which include occupational health concerns.

Evidence of prevailing occupational and environmental work practices have been studied since a decade ago (Enander et al., 1998) especially about exposure to chemical hazards and solvents (Woskie et al., 2004 and Enander et al., 2004). Occupational health studies have been conducted mainly in developed countries such as United States, countries within Western Europe and Australia have (Redlich et al., 2001 and Alexanderson et al., 1987).

Workers in automotive body shops daily use materials and products that may contain hazardous components such as isocyanates, solvents, heavy metals among others. The main effects of hazardous exposures are occupational asthma and other lung problems, as well as irritation of the eyes, nose, throat, and skin. (OSHA,2006). According to Di Stefano (2004) and Redlich (2006) spray painters are more likely to develop asthma compared to other

occupations. Pronk (2006) and Bello (2004) refers to isocyanates as one of the most common causes of occupational asthma in workers from industrialized countries. The major contributors of exposure to isocyanates group are the polyisocyanates which are inadequately regulated in many work places (Bello, 2004). The isocyanates exposure characterization is often limited to airborne exposure (Liu, 2000). In an epidemiological study conducted in New Haven, U.S. found hexamethylene diisocyanate (HDI) in the blood of auto body shop workers; although there were no records of asthma because this finding, workers reported respiratory problems (Redlich, 2001). The workers on shops faces are also exposed to numerous physical hazards such as burns, cuts from sharp objects, and injury in eyes (CESVI, 2006).

Hazardous wastes in auto body shops are not insignificant (Enander et al., 2003); chemicals not only may harm workers but also they may pollute the environment. A report from the U.S Environmental Protection Agency (2000) estimate this industry emits 70,420 tons per year of volatile organic compounds (VOCs); from those, 11,155 tons per year were generated by small auto body shops. EPA also estimates that more of 150,000 workers in the U.S. auto body shops have been affected by toxic emissions (EPA, 2002).

2. Methods

As previously explained, the sustainable service program has its foundation on a multi-tiered research. The first leg of the study consisted on surveying several Mexican auto body shops to characterizing this industry; researchers gather data about economics, demographics and dynamics trends, occupational and environmental work practices, regulatory framework and current practices, as well as identifying opportunities to improve actual occupational conditions and environmental performance.

The study was conducted in the city of Hermosillo, the Capital of the State of Sonora, Mexico, which has experienced substantial economic growth and industrial development since 1986 when Ford Motor Co. opened a manufacturing plant in the city. The rapid industrial development was accompanied by a fast growth of automobile ownership. According to the 2004 Census, the number of cars on the road in Hermosillo increased from approximately 69,200 in 1989 to 214,000 in 2004, a 3 fold increase (INEGI, 2004) Traffic-related auto accidents also increased by almost 30% from 4,880 in 1999 to 6,275 in 2003 (INEGI,2004). In response to the high rate of auto accidents, the government of Sonora passed a new transit law in January 2006, which enforced third-party liability insurance for all auto operators with residence in Hermosillo. Because this reality; the increased number of cars on the road, accident rates, and the third-party insurance law; it is expected an increment on the job demand and the volume of services in auto body repair shops.

This first phase of the study was based on an inductive reasoning; it consisted on observing specific work practices in 40 Mexican auto body shops; then, generating broader generalizations and theories to create, in the second phase, a Sustainable Service Program framework that responds to the necessities and characteristics of small sized auto body shops.

3. Automotive refinishing industry's profile

The Mexican auto body industry is formed mainly of family-owned business that has little capital to invest in technology; the workers in these shops generally operate in unhealthy working conditions. The average shop is often set up on the back yard of the house, and

most of the pre-paint work is done either on the street, the yard, or an open bay area with a bare ceiling/cover for shade without little or no engineering controls for exposure. Improvised enclosure areas are used as spray booths. Such enclosures typically did not have sufficient light and artificial ventilation.

The average shop has been on the market for 13 years and has a workload of 15 cars per month generating a current annual income of US$15,400. The average shop has four full-time employees; the auto mechanics perform only engine repairs, whereas technicians, in addition to body work, typically perform all painting, unless it requires great specialty which it is done by specialized painters. Although technicians spend most of the time on pre-painting preparatory tasks, they preferred to refer to themselves as painters. Nearly all shops participating in the study were located in residential areas.

The labor market relies on personal contacts in Sonora, Mexico to a far greater extent that in the US. The work as well as its management is organized differently as well.

In spite of the fact that tasks in the Sonoran auto body shops are very similar to those described in the literature for the US auto body shops, services are often processed in batches (e.g. mechanical repairs of all cars, then bondo on all, then painting of all at once) rather than in a single car-full repair model.

Work practices are tremendously variable, and written records are rarely maintained and/or inaccessible. It is common practice to hire outside dedicated spray painters to complete jobs as demand arises, especially for specialty jobs. Therefore, painters may work for two or more auto body shops during the same week and in the spare time work on second jobs. Tasks duration as everywhere varied largely depending on the extent of the car's damage.

4. Unsustainability patterns

To ensure that the Sustainable Service Program is connected to the real world; the scheme presented has as a foundation the occupational and pollution prevention findings from this multi-tiered research that have been already published in peer-reviewed international journals (Velazquez et al., 2008 and Munguia et al., 2009).

Key findings of previous tiers suggest the lack of good environmental and occupational and safety practices performed in the auto body shop industry. Today's trends in auto body shops are going in an unsustainable direction, workers work in unhealthy and unsafe settings. In spite of working with well-known hazardous chemicals, notably isocyanates, methylene chloride, welding fumes, and chromium and lead, workers accept these risks as a part of their jobs.

The Sonoran auto body workers usually wear disposable dust masks that offer no protection against solvent vapors and little protection from fine aerosols. Training program on occupational safety and hygiene are needed because the workforce lacks basic education and training on workplace hazards and safer work practices.

Facilities did not have engineering controls and in the best situation, they were inadequate. As a family business, almost all participant shops were located on the back yard of their house, and the pre-paint task was done either on the street, the yard, or an open bay area with a primitive ceiling/cover for shade. Usually, owners improvise an enclosure area as spray booths. These areas do not count with sufficient light, and ventilation.

Environmental practices in the Sonoran auto body shops were found inappropriate for reducing the impact of these small businesses on the environment. Much of the solvent is

emitted to the atmosphere as volatile organic emissions because the lack of enclosed gun cleaning systems. In addition, overspray isocyanates and base coat aerosols may be also released in the surrounding community. Liquid paint waste is typically dumped in the sink or soil, and solid hazardous waste is treated as regular municipal waste. In essence, these shops dump all their pollution in their own backyard.

Housekeeping, handling and storage of materials were found to be significant associated with poor safety conditions. Solvent and isocyanates were commonly stored in inadequate containers which were either not labeled at all, or hand labeled with a marker.

Changing these unsustainability patterns of service in the auto body industry would have implications for many different stakeholders in this process; yet, owners of shops have more accountability. They must assume the responsibility of the negative occupational and environmental effects of their current practices.

The Sustainable Service Program is a management strategy for helping auto body shops to shift unsustainability patterns in this industry through a better understanding of the human health and environmental impacts of materials, processes, and activities.

5. Sustainable service program

The Sustainable Service Program reflects the philosophy of sustainable development understood as a broad structural approach that takes into account economic, social, and environment aspects. The program´s framework is based on a continuous improvement, the plan – do – check – act cycle, which identifies areas of opportunity and then, proposes ideas for solving problems. This iterative process must be repeatedly executed in order to achieve goals. With each succeed iteration, the organization advance toward sustainability.

The Sustainable Service Program is an adaptation of classic Cleaner Production and Pollution Prevention Programs, but it focuses more on the particularities of a small service organization. Tangibility is perhaps the main difference between goods and services production; yet, the production of services requires goods that may impose harm to workers and environment; from this perspective, a Sustainable Service Program does not differ too much from cleaner production and pollution prevention programs because they are concerned with make interventions at the source.

The ultimate goal of a Sustainable Service Program is to prevent, eliminate and/or reduce, at the source, the creations of risks or severe impacts that processes, operations or activities can impose to workers, environment, and society.

Designing a Service Sustainable Program, exhibit in figure 1, involves five stages: management support, planning, implementing, checking, and acting.

Stage 1: Management Support

A typical recommendation when setting a program is to get management support because it is understood that without management support it is very hard to make changes. In succeed organizations, high administration set goals and policies, allocate resources and then, managers at all levels supervise working practices to make sure everything runs according their plan.

Unfortunately, owners in small auto body shops have poor management styles and not to say poor sustainability knowledge. In consequence, gaining management support requires periodical visits to explain them how workers and environment are affected in other auto body shops around the world and how they can reduce these risks and impacts by

implementing such a program. Cases studies from world-wide experiences showing example of good, or even bad, practices are excellent auxiliary materials to create sympathy for sustainability.

In general, once owners are aware of the potential benefits of the sustainable program, they are interested in supporting changes and willing to establish a sustainable service program as a way to reduce its liability and promote sustainability. Additionally, the lack of managerial structure makes easier to start from the scratch which is very difficult in well established companies where organizational structures make decisions from top to down are hard to change.

Sustainability commitment must be written on a formal document called mission statement; yet, it is very likely the lack of missions in auto body shops. Therefore, it is necessary to work in mission statement that will tell customers and groups of interest the inspiration and motivation of the auto body shop for sustainability. This statement will lead future practices not only about sustainability but also about general practices. A basic mission statement can be:

"The name of the shop" is an auto body shop with more than 10 years of service to the community and is committed to promote Sustainable Development by preventing, reducing or eliminating the use of toxic substances that harm the environment or employees through a continuous improvement process.

Like this mission statement can be many other, the importance is to prove a real commitment to take care of workers, environment, and society. Equally important is the definition of sustainability policies that basically are the means to successfully achieve the mission. A policy leads the aim of the goals and objectives and also the procedures to fulfill the goals.

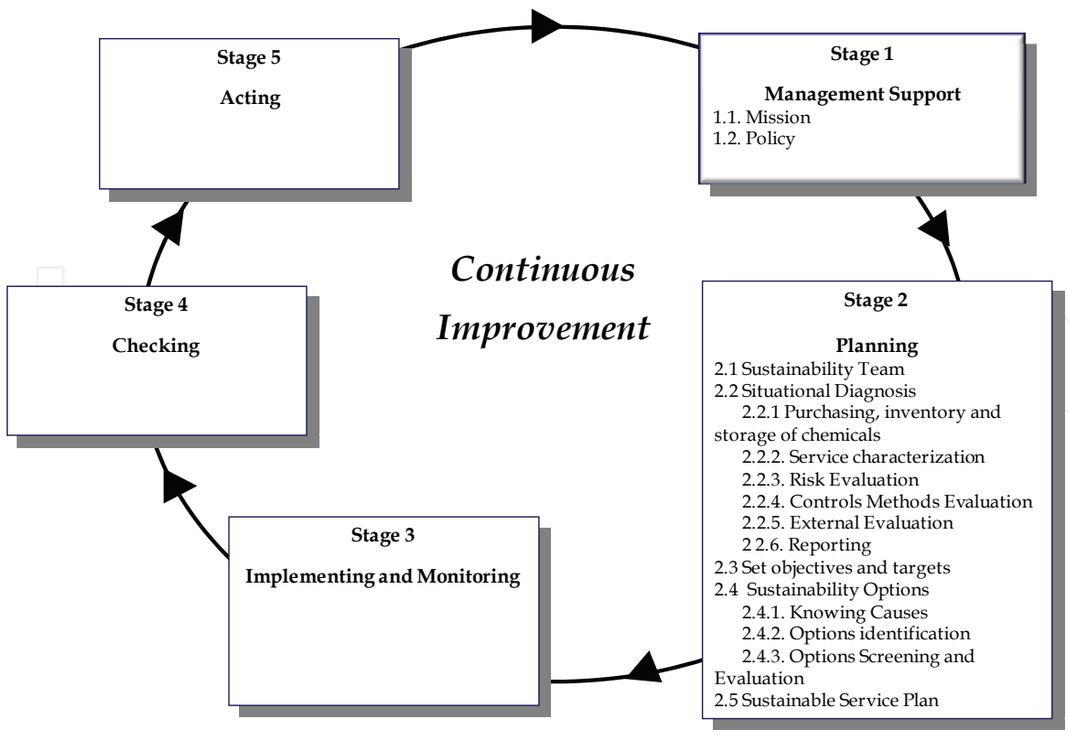

Fig. 1. Sustainable Service Program Scheme

In a typical auto body shop, there are several elements that prevent the establishment of sustainability policies perhaps the main obstacle is its informal organization where owners have the privilege of making all decisions in the shop; however, if the owner has a truly commitment to sustainability he/she will set policies to promote it.
A sustainability policy can be as simple as:

- Whatever possible, it will be bought ecological paint and goods used to repair cars.
- All workers will wear personal protective equipment,
- It is encouraged energy conservation initiatives,
- And so on.

Of course, there is a need for putting emphasis in the enforcement of polices in order to effectively promote sustainability.

Stage 2: Planning

At this point, it is necessary to address the efforts of the team to identify and document the core processes for delivering the service. The product of this stage is a detailed plan regarding future initiatives for improvement environmental and occupational conditions at the shop. The success of the Sustainable Service Program depends on a goon planning; for that reason, this is a critical phase of the program mainly during the first iteration when nothing or almost nothing is known or documented.
Again, the logic to start this phase in a small auto body shops notoriously differ from big organizations because on these organizations high administration set the goals and objectives; then, it is assigned accountability to managers or supervisors to be sure that the goals and objectives are met. In small organization, the creation of the sustainability team is necessary before the establishment of objectives.
The role of the consultant in this stage is to obtain information from the owner and workers and after that, write a formal document which is going to be the written plan. The leader asks the "what" and the "how" and the owner and the workers answer the questions according to their empirical knowledge. Observation of current practices during walkthroughs in the shop is another technique that results useful to identify sustainability opportunities.
The sustainability team is constituted by the owner, the workers, and the graduate student that for her/his sustainability knowledge and skills plays the role of the leader as if he/she were an external consultant. It is a small team whose purpose is to do a diagnosis, set the objectives, look for opportunities, generate alternatives, and evaluate them to hierarchy.
During the first iteration of the program, the leader works along with the owner and the workers overseen the process of creating, maintaining, monitoring, and evaluating the program to be sure it succeed; subsequently, for next iteration, the consultant must left the program on the hands of the owner and workers. If necessary, the consultant intervenes again in specific problematic during the second or following iterations; however, the goal is to eliminate the dependence of the auto body shop's stakeholders by building their capacity.

2.1 Situational Diagnosis

The purpose of the diagnosis is identifying all data that could be helpful in reveal occupational and environmental risks as well as risks to society generated in the auto body shop as a foundation to set goals.
Because at the beginning of the program, during the first iteration of the PDCA cycle, records are not available; it is necessary to conduct a detailed materials accounting and a

work practice assessment. Once the first iteration is done and the cycle starts again, data are going to be useful as a preliminary assessment and then, another detailed assessment will be necessary under new conditions.

Understanding how the service is done is indispensable to identify occupational and environmental risks. A service analysis is the first step to performance the service characterization; saying in other words, how inputs are used for producing the service. A material accounting is a complete inventory and assessment of all materials through the process from when they are bought to when they are released or disposal. It is important to be aware that although some materials are easy to track; others, like chemicals, are more difficult because they can be found as constituents in products, raw materials or be present as by-products.

2.2.1 Purchasing, inventory and storage of chemicals

The first target is aimed at identifying general aspects of the processes of purchasing, inventory and storage. The process of buying in shops is very simple; basically, the damage in the automobile determines how much to buy and the owners decide where to buy. Generally, they don't have influence over aspect such quality, packaging or prices.

The automotive refinishing industry usually buy products that contains hazardous chemicals such as isocyanates, solvents, and heavy metals which have the potential to pollute the environment and have adverse effects on workers' health.

Packaging used to contain paints and solvents requires special attention because this is disposal after single use increasing the generation hazardous waste that is hard to reuse or recycle. In addition, the absence of adequate labelling increases the chances of an accident.

Owners must strive to avoid buying toxic and hazardous materials which most of the time are inherent in the materials used to produce the service such as paints and solvents. By toxic, it is understood any substance that pose a harm to humans and environment.

It is desirable the use of minimum inventory level of toxic substances as in a just in time system; in addition, it is necessary to establish a storage procedure for hazardous substances aimed at avoid foreseeable circumstances that may results in potential problems such as spills, fugitive emissions, explosions, fire, or accidents.

Toxic substances must be storage in secure containers and correctly labelled. Compatibility is the criteria for storage toxics substances; chemical with same characteristics are less susceptible to cause dangerous reactions if the container is accidentally torn; yet, the store procedure also has to consider the place when the chemicals are going to be stored to be sure they are going to be manageable, this includes a good housekeeping.

2.2.2 Service characterization

The service is analyzed by using a process flowchart containing symbols to identify the elements of a process; for instance: tasks with rectangles and flows with arrows. In auto body shop there are two core processes: painting and mechanic work; their flowcharts are shown at figure 2 and figure 3.

Once the process has been depicted, the following step is to specify the work activities of workers. Ergonomics considerations are very important to describe the physical arrangement of work stations and tools used by workers to perform their tasks.

Describing work methods is also important to identify occupational risks and also to know waste sources; the leader must ask and observe what is done and how the task is done. The intention is to create a process chart with a clear description of all activities in the core

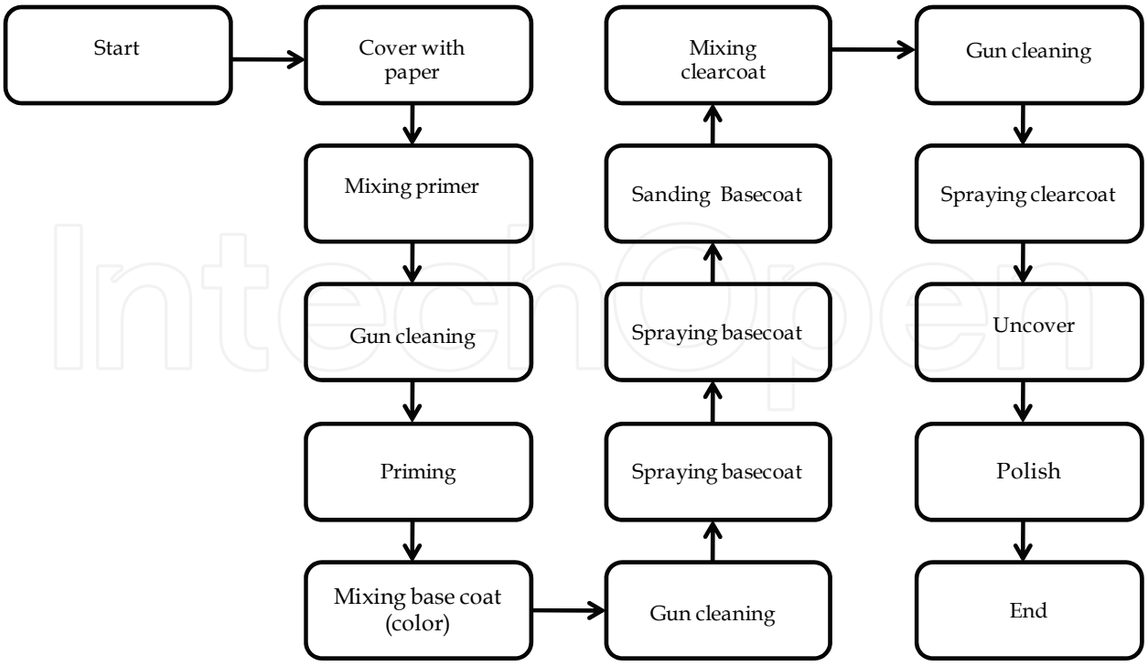

Fig. 2. Painting process flowchart

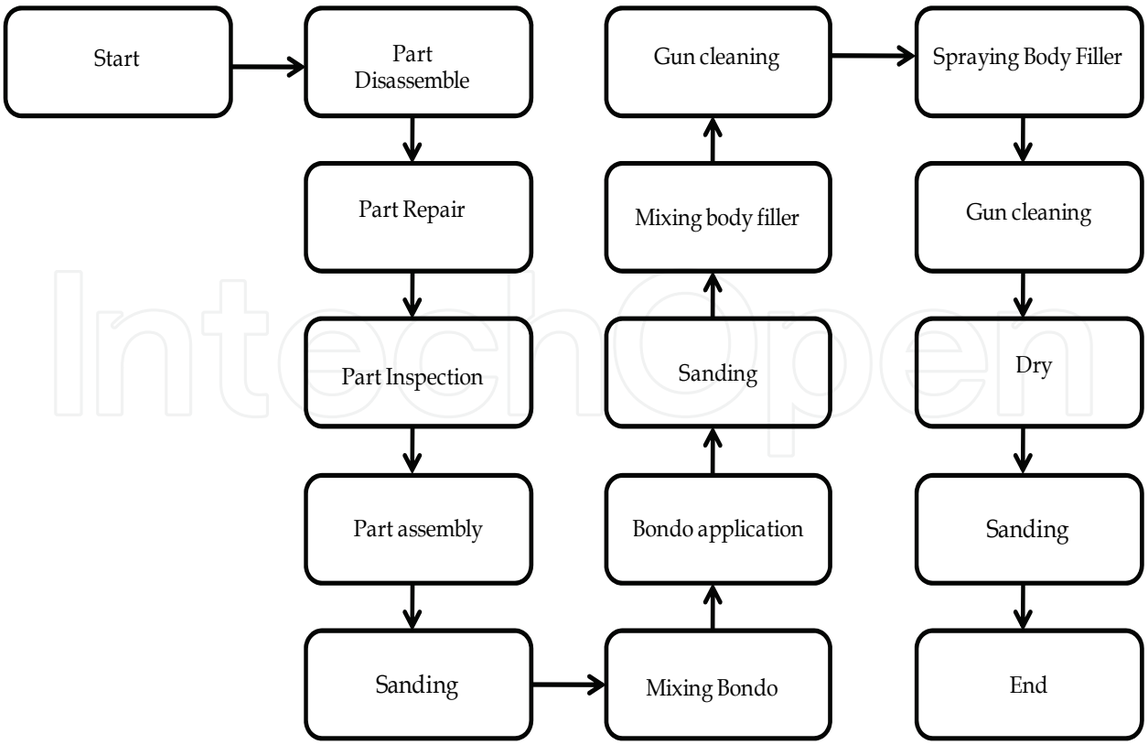

Fig. 3. Mechanic work flowchart

Process Chart

DESCRIPTION	SYMBOL	TIME	DISTANCE	OBS.
Part Disassemble	● ⇨ D □ ▽	40 min		
Part Repair	● ⇨ D □ ▽	25 min		
Inspection	○ ⇨ D ■ ▽	5 min		
Part assembly	● ⇨ D □ ▽	.5 min		
Sandin	● ⇨ D □ ▽	10 min		
Mixing Bondo	● ⇨ D □ ▽	4 min		
Bondo application	● ⇨ D □ ▽	10 min		
Sanding with sandpaper #36	● ⇨ D □ ▽	10 min		
Sanding with sandpaper #80	● ⇨ D □ ▽	30 min		
Drying	● ⇨ D □ ▽	10 min		
Mixing body filler	● ⇨ D □ ▽	5 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Spraying Body Filler	● ⇨ D □ ▽	5 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Drying	○ ⇨ ◗ □ ▽	5 min		
Sanding with sandpaper #400 o #1200	● ⇨ D □ ▽	60 min		
Cover with paper	● ⇨ D □ ▽	20 min		
Mixing primer	● ⇨ D □ ▽	5 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Priming	● ⇨ D □ ▽	5 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Part transport to the paint area	○ ➡ D □ ▽	5 min		
Mixing base coat (color)	● ⇨ D □ ▽	10 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Spraying basecoat	● ⇨ D □ ▽	10 min		
Drying	○ ⇨ ◗ □ ▽	60 min		
Spraying basecoat	● ⇨ D □ ▽	10 min		
Sanding basecoat	● ⇨ D □ ▽	60 min		
Mixing clearcoat	● ⇨ D □ ▽	10 min		
Gun cleaning	● ⇨ D □ ▽	3 min		
Sraying clearcoat	● ⇨ D □ ▽	10 min		
Uncover	● ⇨ D □ ▽	5 min		
Drying	○ ⇨ ◗ □ ▽	5 min		
Polish	● ⇨ D □ ▽	30 min		
Final inspection	○ ⇨ D ■ ▽	3 min		

processes with their time requirements. Often activities in auto body shops are non-standardized and non-paced; therefore, characterizing these processes requires studying several services given in different automobiles because the damage varies from one car to another. Figure 4 shows a process chart for core processes in an auto body shop. The characterization of the service concludes studying the interaction of workers with equipment.

2.2.3 Risks evaluation

The service characterization allows a full understanding of the service and consequently, the identification of sources of occupational and environmental risks. The assessment includes not only the identification but also the evaluation of risks. Chemical, mechanical, physical and ergonomics hazards are often found in different magnitude at auto body shops; for the reason, it is necessary to conduct an assessment to estimate the probability to cause harm.
Evidently, chemicals are the biggest concern because they can cause serious adverse health effect or even death. The assessment of chemicals hazards depend on their toxicity, the ability of a substance to produce an unwanted effect, and their hazardous, the probability that chemicals cause poisoning given certain conditions. The most common routes of entry in the shops are inhalation and skin absorption.
Collecting sampling is required for measuring chemicals concentration in the air; results must met specific standards determined to provide a healthy work environment. Once chemicals are discarded, they have the potential to pollute the environment; therefore, it is also necessary to compliance with environmental standards.
Other hazards at auto body shops includes cuts, heat , noise, and bad postures can cause fatigue and musculoskeletal disorders; each of these and other risks must be assess and compare against occupational standards to be sure their magnitude don't represent a threat for workers.

2.2.4 Controls methods Evaluation

This assessment is conducted to identify and evaluate the engineering and administrative controls as well as personal protective equipment on place to protect workers from workplaces hazards.
Engineering controls remove hazards from the work stations or isolate workers from the hazard to avoid damage. They are effective, but have the inconvenient of being expensive. Ventilation, barriers and enclosures are typical examples of engineering controls. Administrative controls are used as complement of engineering controls; they reduce the period of exposition of workers to hazards. It includes: training and education, job rotation, reducing the period of time of exposition to particular risks and other administrative alternatives.
Personal protective equipment is required to provide protection for limited periods of working; often this method is ineffective because workers feel uncomfortable when performing their tasks. Yet, when other methods are not enough to control exposure it is recommendable to wear gloves, respiratory masks, goggles or other necessary equipment.

2.2.5 External evaluation

Service organizations requires interaction with the customers to produce the service; on this context, a Sustainable Service Program cannot not be created, maintained and operated in a vacuum; at the contrary, this must be linked to all stakeholders and other groups of interest even outside of the company.

External factors are those facts over which the auto body shop has not direct control such as the legal framework, clean technology, relations with neighbourhoods and civil protection groups, and so on. The external assessment is often ignored; however, owners need to be aware of external factors because they are constantly changing and might affect the business.

2.2.6 Reporting

The diagnosis has been satisfactorily concluded when the service has been characterized and most of the sustainability risks along the service have been identified and document in a baseline report. The mission, the goal and findings in this report are the basis for establishing objectives and targets.

It is necessary to include in the report a prioritization of occupational and environmental risks based on some criteria such the feasibility to prevent, reduce or eliminate, the potential to harm workers or pollute the environment, risk magnitude, or any other criterion that the team consider useful. Compliance with National Official Standards is critical to prioritize the risks; if there are magnitudes above standards, an objective in the program must be to compliance with all standards.

2.3 Set objectives and targets

As mentioned lines above, the goal of the a Sustainable Service Program is to prevent, eliminate and/or reduce, at the source, the creations of risks or severe impacts that processes, operations or activities can impose to workers, environment, and society. This goal defines a general direction to accomplish the sustainability mission in the long term.

At this point, when diagnosis has revealed areas to focus on, it is possible for the sustainability team the establishment of objectives. Objectives are milestones that serve as specifics guidelines to be met in a short term. Objectives must be clearly stated in the written program; an objective must be understandable, achievable, measurable, and have a specific term to be accomplished. Targets are quantifiable measures for reach objectives; for example:

Objective: "Decrease the generation of hazardous waste this year"

Targets:

- *Reduce hazardous solid waste by 50%*
- *Reduce solvent air emission by 10%*
- *Implement an efficient method of storage for chemicals.*

It is important to avoid operational conflicts by being certain that targets are useful for the accomplishment of objectives; objectives are useful for the accomplishment of the goal, and the goal of the program is consistent with the sustainability mission.

2.4 Sustainability options

2.4.1 Knowing causes

A risk is not eliminate just because it was identified; it is necessary to know the causes that origin it; cause and effect diagrams are helpful to explore causes that result in a single workplace hazard or environmental risk. Preferably, the team must think about all causes and not only the most obvious.

It is necessary to include in the report a prioritization of occupational and environmental risks based on some criteria such the feasibility to be prevented, reduced or eliminated, the

potential to harm workers or pollute the environment, or any other that the team consider useful.

The cause and effect diagram can depict as many causes as the team considers convenient; however, follow the issues in the assessment results a good start. For instance: toxic materials, bad storage, low- efficiency equipment, un-training workers, process, etc. Figure 5 and 6 show the cause and effect diagrams for typical environmental and an occupational risks within an auto body shops.

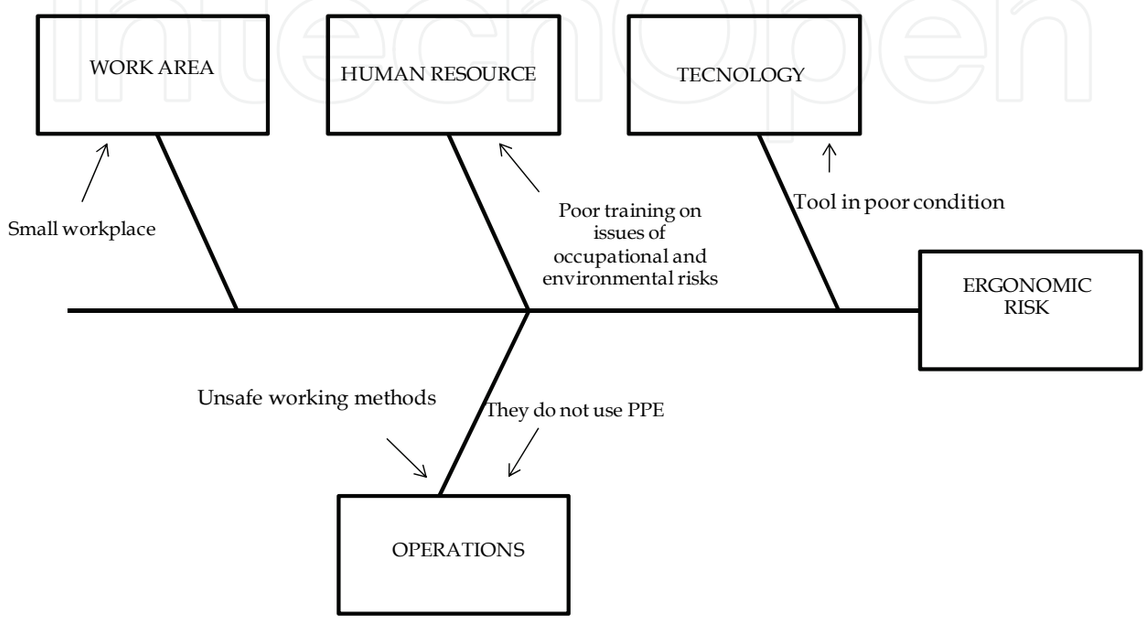

Fig. 5. Cause and effect diagrams for typical occupational risk

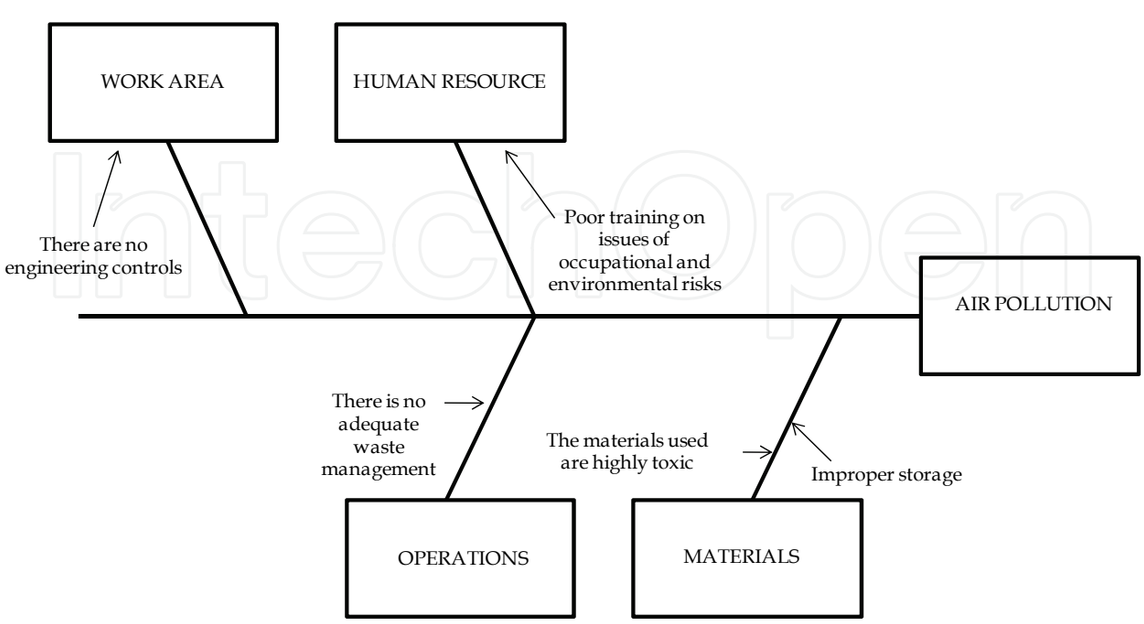

Fig. 6. Cause and effect diagrams for typical environmental risk

2.4.2 Options identification

Once causes that origin the risks are known, the leader must start discussions within the team regarding finding sustainability options aimed at first eliminating and, if this is not possible, reducing their impacts. It is necessary to identify causes for all single risk already identified; however, the generation of sustainability options will be first for the risks that were ranked high in terms of feasibility or importance.

There are several sources for generating option; for instance, brainstorming that allows gathering as many options as possible from the simplest to the most complex. In this technique, creativity and participation are encouraged and no ideas are discarded by any reason, at least, they are not based on sustainable principles; this that options create bigger risks or affect quality. Suppliers are another source for getting good ideas as well as literature on internet, books and others divulgation means.

2.4.3 Options Screening and Evaluation

All identified options must be screened and then narrowed into a prioritized list for each risk. Sustainability options are screening out based on their feasibility, ease of implementation and effectiveness. Prevention is always preferable than control to decide the initial screening.

The options selected must be evaluated for technical, environmental and health, financial, and social feasibility; this is a simple evaluation that consists most of the times only on gathering technical data about options in the market; mainly local market.

Small auto body shops are not technology-intensive shops; technological options range from substitution of raw materials to equipment used to produce the service; inclusive personal protective equipment options are considered in this assessment. For instance, if the option is to switch from a toxic chemical t to another less toxic chemical; then, it is necessary to think about potential obstacles that might affect the implementation of the option such as if the technology option is available at local or regional market, if switching might decrease the quality of the service, if there is evidence on its effectiveness, and so on.

A special attention is also required to assess if the proposed option, chemicals switching, is going to create a new, even worst, environmental or occupational hazard. This is a complicated analysis because the lack of conclusive information on chemicals, even for those chemicals which have been extensively studied such as isocyanates and solvents. Therefore, efforts are addressed to obtain as much information as possible for a better understanding of the option.

If that option is found feasible, an economic assessment is required; often, the option is accepted as long as this is affordable. However, any investment in proposed options, mainly in equipment, requires a justification at least in terms of payback.

The payback period refers to the period of time required to recover an investment; the payback is calculate with the equation: investment/ annual cash inflow; this is a simple and convenient measure of profitability; however, for a better analysis, the payback period method has to be complemented with other method such as the accounting rate of return.

Last but not least, the social assessment provides an opportunity for consulting external stakeholders about the potential affectations derivate when implementing the proposed option. Following the example of the material switching, owners should find what society think about a new paint or if the proposed option is to buy a new compressor for painting, it is necessary to know if noise will bother neighbours. Knowing on advance what is going to

generate conflicts with society enable auto body shops to think twice the implementation of an alternative just taking into account technological and financial aspects.

2.5 Sustainable Service Plan

This is a written plan used as a guide for actions to achieve the goal of the Sustainable Service Program. There is not a single format to present a plan; yet, all items of the planning stage from mission statement to selected options, must to be clearly stated within the plan in order to reduce the occurrence of misperceptions.

This plan provides the basis for the implementation of the options that resulted feasible; however, not all feasible options have to be taken into account in the initial written plan. Despite their feasibility, some options are left to following iterations on an options waiting list. It is important to consider a contingency plan section in order to opportunely react in case of an accident or something doesn't occur as expected.

Stage 3: Implementing and Monitoring

The resources allocation to secure the implementation of the options that were foreseen in the planning stage is the purpose on this stage. Implementation projects describing the labor, technological, and financial resources indispensable to carry out them are done for each of the options. The details about the resources allocation will depend on the auto body shop´s structure, but at least, this has to cover the duration of the activities necessary for the logistics to which it refers.

Monitoring is done to evaluate the efficiency of the options implemented and based on results; some projects could need to adjust them. Efficiency has to be measure not only in engineering or financial terms but also in health and environmental terms. Besides monitoring quality service factors, the program encourages to be annually monitoring the health conditions of workers in order to prevent occupational illness. Recognition of occupational and environmental hazards is also important when monitoring the program.

Sustainability indicators are one of the most important elements in the monitoring stage. They must provide reliable, relevant, and useful information about relevant factors such as waste, water, energy, noise, emissions and so on; therefore, the sustainability team must collect information for interpreting indicators to make decisions about how the projects have been working according to the goals of the program.

One of main challenges in monitoring the implementation of options is the involvement of workers and the main requirement is to prepare workers with the necessary knowledge and skills. Training is vital for assure a good implementation and also for monitoring the implementation because it enables workers not only to increase the productivity of the service but also to reduce their exposure by recognizing occupational and environmental risks on advance to possible impacts.

The Sustainable Service Program does not demand engineering skills to identify eliminate or reduce new hazards that might recently exist. It only requires getting observations of practical situations that are desirable for ensure appropriate interventions, but without being a data intensive activity.

Safety Material Data Sheets are excellent sources of information because they provide data for coping with chemical substances or products such as their physical data, toxicity, health effects and they may also include storage, disposal, labelling and other safety procedures to reduce exposure. Unfortunately, information in safety sheets is hard to understand for worker; consequently, training sessions should include how to understand and use them.

Stage 4: Checking

At this stage, the team review the information collected to find out if data fits with the goal and objectives of the program. The check stage tests the plan for completeness and if there are deviations from the initial plan are found, the team must make decisions to reorient current projects. In some cases checking reveals the need for review objectives rather than particular projects. Preferably, options should be checked on a continuous basis.

Stage 5: Acting

It is particularly desirable that the results of checking server as a feedback for acting. Taking corrective actions is often necessary to keep on the planning track toward reach objectives. Decisions can be from small modifications to cancel the project and select another option from the options waiting list. On the other hand, if objectives have been reached, the team must start the cycle again by strengthen the program and set new objectives to keep reaching sustainability.

6. Conclusions

Automakers have reduced the environmental impacts of motor vehicles by making cars more fuel efficient and conserving natural resources. Unfortunately, cleaner technology has been not sufficient to reach sustainability in this industry. When study the sustainability of the automotive industry, it is a common mistake to pay attention only to the automobile. The automotive system is complex and environmental and social impacts are generated not only in the manufacture and use of car, but also in the services necessaries to keep the car appropriately working.

The service offered in the Mexican auto body shop is clearly not consistent with the accepted precepts of sustainability because it is not addressing the underlying sustainability principles of protect the environment and improving health and safety conditions within shops.

The implementation of a Sustainable Service Program is not sufficient to guarantee sustainability in this industry; but it increases the chances of small auto body shops to develop services strategies to secure long-term economic growth while improving environmental and working conditions.

The goal of preventing, eliminating, and/or reducing, at the source, the creations of risks or severe impacts that processes, operations or activities can impose to workers, environment, and society cannot be achieved without an honest commitment to sustainability from owners and workers in auto body shops.

Even objectives were achieved, it is necessary to sustain success. Continuous improvement ensures that the program does not stop after the first iteration of the cycle. The sustainable service program is a tool to help small service organizations to transit in incremental steps to Sustainable Development.

It has been stated in this chapter that the major accountability for changing unsustainability patterns of services in this industry falls on the shoulders of auto body shops´ owners; unfortunately, they are not in conditions to achieve this goal for themselves.

Around the world, there are examples of positive collaboration between society and universities. Higher education institutions are in an incomparable position of helping small auto body owner to transit to sustainability by implementing the proposed Sustainable Service Program because their mutual interest for pushing for clean production and better

working conditions and because the moral obligation of universities for involving in regional development process by developing clean technology, green and safety process, testing new chemicals, and in general making workplaces safe.

As a part of the research; nowadays, the Sustainable Service Program is being testing in a variety of small auto body shops in different Mexican settings. Hence, it is very likely that some stages and activities in the model would have to be debated and adapted, but the main arguments might provide the means necessary to overcome the barriers confronted by sustainable advocators in their particular situations in specific shops.

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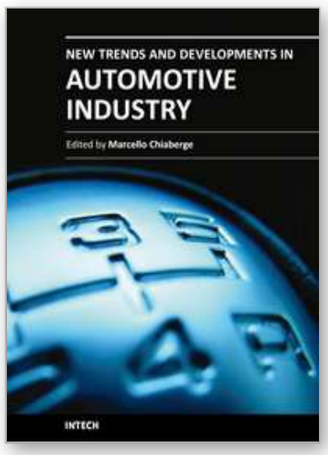

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This book is divided in five main parts (production technology, system production, machinery, design and materials) and tries to show emerging solutions in automotive industry fields related to OEMs and no-OEMs sectors in order to show the vitality of this leading industry for worldwide economies and related important impacts on other industrial sectors and their environmental sub-products.

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