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Best practices in implementing operational controls of ISO 14001 environmental management systems into small and medium businesses

Kuldeep Khalsa

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BEST PRACTICES IN IMPLEMENTING OPERATIONAL CONTROLS OF ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEMS INTO SMALL AND MEDIUM BUSINESSES

THESIS

BY

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JULY, 2003

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT.

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Without patience, encouragement and support of many people, this thesis could not have been realized. I wish to thank many people who have, in one way or the other, made this thesis possible.

I am deeply indebted to my advisor Dr. John Morelli whose help, stimulating suggestions and encouragement helped me in all time of research for and writing of this thesis. I also want to thank Dr. Jennifer Schneider, Prof Maureen Valentine and Prof Joseph Rosenbeck, who have given me excellent guidance from the time I started this program.

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I would like to thank all my friends and colleagues at R.I.T for their support and friendship and for all the care they have provided.

Finally, I would like to thank my parents Mrs. Balbir Kaur and Ms. D.B. Khalsa and my sister Meetali for their support through the years. Lastly and most importantly I wish to give a very special thank you and all my love to my Fiancée Sneha for all her help during this dissertation.
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ABSTRACT

Studies show that many small and medium businesses (SMBs) that have implemented environmental management systems (EMSs) and got certified to the ISO 14001 Environmental Management Standard experienced obstacles along the way. For SMBs the standards appear unnecessarily bureaucratic, and represent a way of working that fits poorly into their organizational cultures and decision-making structures of small companies. Studies also show that environmental management systems such as ISO 14001 provide a framework for organizations that wish to effectively manage their environmental affairs. Implementing an EMS that conforms to the ISO 14001 standard helps businesses integrate environmental values into their operations.

This research helps bridge the gap between EMS theory and business practices in SMBs. Its specific goal was to determine how SMBs developed and implemented operational controls in ISO 14001 type environmental management systems in order to help similar SMB’s achieve successful EMS implementation. This thesis identifies the problems that small enterprises experience when they develop and implement operational controls, and examines the approaches that are used to overcome different barriers. It also looks at how different factors interact to facilitate the implementation and certification of EMSs in small enterprises. The main focus of the study is on the US, but some relevant data has been collected from sources outside US.

The main outcomes of the thesis are:
• A description of various methodologies that are used in order to develop and implement operational controls in SMBs

• An analysis of the positive and negative aspects of these methods and

• Recommendations for “Best Practices” to implement operational control in SMBs

• Recommendations on how to effectively develop and implement operational controls in SMBs.
Keywords and Acronyms

DEC - New York State Department of Environmental Conservation
EMS – Environmental Management System
EHSMS – Environmental Health and Safety Management System
EPA – Environmental Protection Agency
EIS – Environmental Impact Statement
ER – Environmental Researcher
EE – Environmental Interviewee
EP – Environmental Professional
GAP Analysis – Geographic Approach to Planning
H&S – Health and Safety
INEM – International Network for Environmental Management
ISO – International Organization for Standardization
ISO 9000 – Standard that defines, establishes and maintains an effective quality system for industries
ISO 14001 – A voluntary standard that specifies requirements for certification of an EMS
JSA – Job Safety Assessment
Large Business – Exceeding 250 employees
MSDS – Material Safety Data Sheet
OSHA – Occupational Safety Health Act
PDCA – Plan, Do, Check, Act
RCRA – Resource Conservation and Recovery Act
SMB – Small to Medium Size Business (companies ranging from 10 – 250 employees)
VPP – Voluntary Protection Program
EXECUTIVE SUMMARY:

The aims of this work are to increase understanding of how environmental management systems (EMS) are developed in small and medium size businesses (SMBs) and find best practices for developing and implementing operational controls in SMBs. The professional literature focusing specifically on development and implementation of operational controls in SMBs was limited to only a few studies on implementation of EMS within some industries in Europe.

This study explores how operational controls are developed in a company using an ISO 14001 type EMS. The characteristics that separate SMB’s from larger companies in their respective approaches to this effort are discussed based on studies and interviews conducted. Some of the studies on ISO 14001 contain guidelines for developing operational controls which represent a key component of ISO 14001 series.

Data about implementing operational control practices were collected from the literature and through interviews with EHS professionals and others working in SMBs and in larger organizations that had provided assistance to SMBs in developing and implementing their EMSs. To obtain information regarding the effectiveness of their operational controls, small and medium ISO certified companies were interviewed.

Most firms reported that the benefits of implementation outweighed the costs. Organizations that implemented the standard have found that ISO 14001 provides an effective, comprehensive framework for environmental management. It also provides the structure necessary to achieve continual improvement in all areas of environmental management, including operational controls.
Implementing operational control is a demanding task requiring top management commitment, understanding of activities, products, and services; employee awareness and much more. There are numerous factors involved in implementing operational controls. Interviews with 15 EHS professionals and others from 11 companies form the study’s empirical base. They represented functions from top management to production, maintenance, health and safety, quality and labor unions. Interviewees were asked about their experience in implementing operational control, the expectations of environmental management systems and how management ideas and visions were promulgated within the organization, this was part of the process that involved workers as well as management. Their responses were used to determine the approach the companies had used to implement operational control.

Small and medium size businesses experienced problems in their work with EMSs. The language in the standards is perceived as bureaucratic and often hard to understand for the representatives of small companies\(^2\). The small companies often have an organizational culture and decision-making structure that might not interact well with the more formal EMS standards and their application.

Small firms lacked specialized personnel with the ability to implement most parts of an EMS on their own, so they relied on consultants. This was partly due to lack of SMB specific material on EMS implementation, but the time pressure in small enterprises can also be a problem.
By conducting interviews the problems of the small companies were revealed, enabling the development of models to facilitate the implementation of operational control in SMBs.

A conclusion of the study is that SMBs have strengths related to their smaller size (compared to larger companies) that can be used in implementing operational controls, but they need to become better aware of them. Additional findings include:

- Identification of significant environmental aspects provides the basis for developing objectives and targets. Both the internal EMS teams as well as outside contractors need more guidelines to be addressed.

- Regulations play an important role and the pressure from them has increased due to new environmental code within the businesses that place more strict requirements for implementing controls.

- The EMS team needs to be aware that management’s true intentions are apparent in SMB’s and affect the company atmosphere and the engagement of the staff. Hence this can be used in many ways to spread the company policy and vision; to engage staff and to increase the co-operation. Conversely the lack of appreciation of environmental issues among management creates problems. Once the EMS process is started, the engagement of staff can become an important driving force. The organization in addition to the management is the most important element in the SME potential.
• Many different approaches to operational controls implementation are possible, but the choice of approach, without proper awareness of it in most companies will affect the management system.

• Certified companies if contacted during implementation phase are willing to provide advice on how to implement controls in order to save time and money.

Some advice to the SMBs:

• Get started, the requirements will more than likely increase in the future.

• Concern for the environment among the staff is there and will show up if the opportunity is provided.

• Create an open atmosphere for communication both within the company and with interested parties for operational controls.

• Provide information for the staff involved in developing operational controls to understand the implementation process and their own contribution to it.

• Encourage employee engagement and suggestions.
CHAPTER I

INTRODUCTION
INTRODUCTION:

SMB’s are gaining Importance......

Small and medium sized businesses are gaining importance in all economies today\(^3\). They also face a lot of expectations and are often mentioned in political speeches as the spearhead expected to drive long term economic development. Although they are strongly focused upon by the authorities, they receive less attention in general discussion. Studies indicate that SMB are not little “big firms” since management practices do not tend to replicate those of larger firms. It cannot therefore be assumed that “what works in large firms will be appropriate in SMBs as well”\(^4\)

SMB’s are slowly getting started......

Environmental activities in industry in the past have traditionally been delegated to someone, to take care of in addition to his/her other duties. Most environmental problems in companies as well as society efforts to solve them are in response to specific incidents and as a part of proactive attempt to improve overall environmental performance. The situation has, however, changed during the last decade. The environmental awareness of the general public has increased and environmental issues have been elevated to the business agenda as the scientific knowledge has increased.

The research concerning environmental issues has, with just a few exceptions\(^5\) mainly involved larger companies and left the small and medium behind. Therefore much less is known of the environmental impact and activities of SMBs, and often much more effort is put into highlighting their problems than solving them\(^6\).
Meanwhile, there have been a number of initiatives trying to find ways to assist SMBs to improve their environmental management and the theme has been discussed in some handbooks as well, but what is taking place in the companies has proven to be rather limited throughout the years.

**Opportunity**

This project work gave me an opportunity to discover how implementing operational control works while applying to a new system. Focusing on ISO 14001, implementation is within itself a chance to see how an environmental health and safety management system (EHSMS) is incorporated and what changes if any need to be made and with what considerations. This opportunity carries itself to form a guideline to future implementation of any new program or system in a corporation that I may be a part of in the future.

This thesis will provide guidance for SMBs to implement EHSMS and develop and implement operational controls, hopefully minimizing their resource use and accomplishing their implementation in a shorter period of time.

**Coincidence of interest**

As an undergraduate and graduate student I have had a number of opportunities to study ISO 14000. I have understood the need for an EHSMS; it helps in providing a framework that can be used to minimize industry’s effect on the environment. Implementing the system and understanding what the best methodology to use when implementing the
system is seen as an opportunity to present it easily to nations that lack the means for technology so if implemented early with evolution of their industries they will be able to minimize and/or better regulate the effect of their industries on the environment.

There is an evolution occurring in businesses requiring a change in systems. Incorporating new ideas into existing systems can move an organization toward new standards and prepare it for the next evolution. Integrating EHSMS and operational control methods into older systems will help keep SMBs in competition if not ahead in their industry.

Special considerations

This study provides a useful tool for assisting SMBs in a variety of countries to develop and implement EMS and specifically, operational controls. ISO 9000 is a name that everyone strives to achieve. ISO 14001 has already been directed onto that path.

Objective of this Study

- To provide a framework for the organization
- To integrate environmental values into operations
- To determine how SMBs developed and implemented operational controls
- To examine problems SMBs faced in developing and implementing operational controls.
CHAPTER II

REVIEW OF LITERATURE & BACKGROUND
REVIEW OF LITERATURE:

Environmental Management Systems & SMBs

Over the past twenty years, with the creation of complex environmental regulations, and mankind's increasingly heavier impact on Earth's resources, businesses have begun to monitor their environmental impacts. Historically, managing environmental issues was not part of a company's strategic decision making process, but businesses have increasingly realized that environmental management is a critical aspect of overall business strategy and success.

An Environmental Management system, or EMS, is a comprehensive approach to managing environmental issues, integrating environment-oriented thinking into every aspect of business management. An EMS ensures environmental considerations are a priority, along with other concerns such as costs, product, quality, investments, productivity and strategic planning. An EMS generally makes a positive impact on company's bottom line. It increases efficiency and focuses on customer needs and marketplace conditions, improving both the company's financial and environmental performance. By using EMS to convert environmental problems into commercial opportunities, companies usually become more competitive.

Management systems standards like ISO 14000 and ISO 9000 are the most commonly known and used way of implementing management systems in organizations. They are geared to provide structure for the organization, responsibilities, procedures, processes and routines and provide a well-structured approach to managing quality and environment, to guarantee products and service that meet stated requirements for quality or maintaining environmental policy. In the same way that the ISO 9000 series of quality
management system standards has transformed the way in which industry manages its quality responsibilities, the advent of the ISO 14000 series EMS standards represents the dawning of a new era for companies managing for the environment.

Developed by ISO Technical Committee 207, the ISO 14000 series of standards addresses environmental management system practices in a global and generic way. These voluntary standards contain no performance requirements, but seek to harmonize valuable environmental principles and practices with a view to helping organizations determine those environmental issues associated with their activities and subsequently manage them most effectively.

The most significant standard, ISO 14001 "Environmental management systems - Specifications with guidance for use," contains management systems requirements against which an organization may measure its EMS performance\(^1\). The ISO 14001 standard is the component of the ISO 14000 series that contains the guidelines for designing an EMS. It is also currently the only standard in the series that is certifiable.

**Main Elements and Purpose of an Environmental Management System:**

Today an EMS is defined as an integral "part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy\(^1\). An EMS is based upon the circular ‘Plan-do-check-act’ model for continual improvements. Implementing and maintaining an EMS would typically follow the scheme below:
An EMS is a voluntary tool, internal tool, which the management can use to approach the environmental issues in an organization in a systematic way. The main elements in an EMS for an organization are, according to the ISO 14001 standard:

- An Environmental policy
- A procedure to identify the environmental aspects of the organizations activities;
- A procedure to identify and have access to legal and other requirements;
- The organization shall establish and maintain documented environmental objectives and targets;
- An environmental management program;
- Defined, documented and communicated roles, responsibilities and authorities;
- Assure appropriate training, awareness and competence within the organization;
- Documentation and documented control;
- Operational Control;
- Emergency preparedness and response;
- Monitoring and measurement;
- Procedures for handling and investigating non-conformances;
- Keep environmental records;
- EMS audits;
- Management reviews.

Regarding the purpose of an EMS, the ISO 14001 standard states that standards for EMS "are intended to provide organizations with the elements of an effective environmental management system which can be integrated with other management requirements, to assist organizations to achieve environmental and economic goals." 

**SMB’s and The Environmental Management Systems:**

Small and medium size businesses are the most important sector of a nations economy. They provide and create jobs, especially during times of recession; they are a source of
innovation and entrepreneurial spirit; they harness individual creative effort; and they create competition and are seedbed for businesses of future. In short, SMBs are vitally important for a healthy dynamic market economy. SMBs are the core of future economic growth in majority of countries. Productivity growth is fueled by competitive processes in industry, which, to large extent, build on the birth and death, entry and exit of smaller firms. They are the source of most new jobs and make significant contributions to innovation and high technology employment. In addition they are of considerable importance for regional development and for social cohesion.

The environmental impacts of small firms are not known either at national or regional levels. It is often widely quoted that, as a sector, SMBs contribute up to 70% of all industrial pollution – a figure that has taken on mythical status. Generally, economic statistics on SMBs do not tally with data collected on emissions, waste generation and effluents from firms, so it is doubtful whether smaller firms contribution to pollution can be calculated at all.  

EMS has lead to environmental improvements in small firms. Very few relevant studies in this area seem to have been made, but the studies have shown that the introduction of certified EMS led to environmental improvements. SMB’s were the last to feel the impact of ISO 14001 drivers and were generally slow to introduce environmental management controls. They recognized their environmental responsibility, the supply chain implications of conducting their business, and the force of public opinion, which through their supply chains made an important impact.
The emergence of international "best practice" companies moving into sustainable development and attracting investment, places a demand on suppliers. This development through the "supply chain" is a major driver for SMBs to address their environmental performance and to go for EMS's.

In recent years, a number of quantitative studies of SMB's in Europe, Australia and USA have identified several trends that seem common to environmental performance of many SMBs\(^{15}\). Salient points of these studies were:

Awareness of formal environmental management systems, specific environmental laws and/or remediation processes is generally quite limited.

**SMB’s Characteristics:**

Since there is no single definition of SMBs, the characteristics in which they differ from large firms and each other can be described and classified in numerous ways. Different characteristics are used in this study to highlight the likely specialties of SMBs, but they overlap to some extent and will in the discussions below that were found to be relevant for the study as well as EMS implementation.

SMBs have in relative terms modest human capital, limited financial resources and know how as well as small scale technology. This may limit the possibilities of long term planning, since most of the effort has to be put into running day-to-day business. Their possibility of spreading the risk by engaging in several development projects simultaneously gets limited\(^{16}\). Most of the SMBs operate in their narrow niche and are able to provide marginally different products and services, which distinguish them from
the more standardized products, or services provided by larger firms. SMBs function as subcontractors to one or few large companies manufacturing a limited number of products that have been developed by the customers. This makes them vulnerable to the actions of their customers especially since these are large and are one of few. The production is single sited and accustomed to the requirements of operations\textsuperscript{17}.

Study showed that more informal and flat organization with short decision chains provides the opportunity to have direct contact between different functions and decision makers in SMBs and enables fast decisions. The SMBs tend to be more result than control oriented as opposed to larger companies and evaluation, control and reporting procedures are often more informal. The management is close to everyone and it is easier to create a corporate mindset and common culture in the company since SMBs can also be seen as groups of individuals trying to achieve their vision through the company. SMBs are often more people dominated (except the very high tech companies), and the degree of specialization is lower than in larger companies. The staff is therefore able to move between different tasks. It is also easier for people to see the results of their work and less formal environment is likely to attract more creative talents who would find it difficult to adjust to the bureaucracy of larger companies\textsuperscript{18}.

SMBs can be characterized by greater flexibility, evolution and change in regard to new products, markets and organization than larger companies, which are bound to have a more stable structure. They are generally less automated, but are on the other hand more flexible to adjust their production to the varying market demand and special requirements from the consumer, whereas larger firms have to use their advantage of
scale, i.e. manufacturing a long series of products to use their advantage of scale, i.e. manufacturing a long series of products to meet a secure demand.

Table 2.1: A summary of the characteristics of SMBs in comparison to larger organizations. Modified by the author from Ghobadian et al.

<table>
<thead>
<tr>
<th>SMB Characteristic</th>
<th>SMB in Comparison to larger companies</th>
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<tbody>
<tr>
<td>Resources</td>
<td>Modest human capital, financial resources and know how few development projects</td>
</tr>
<tr>
<td>Market</td>
<td>Limited external contacts</td>
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<tr>
<td></td>
<td>A narrow niche</td>
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<td></td>
<td>Often price takers</td>
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<td></td>
<td>Dependent on a few large customers</td>
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<td></td>
<td>Less export</td>
</tr>
<tr>
<td>Management and Ownership</td>
<td>Very few layers of management</td>
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<tr>
<td></td>
<td>Top management highly visible and close to the operations</td>
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<td></td>
<td>Incidence of “gut feeling” decisions more prevalent</td>
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<tr>
<td></td>
<td>Dominated by Pioneers and entrepreneurs</td>
</tr>
<tr>
<td></td>
<td>Range of management styles: directive, paternal, Patronage</td>
</tr>
<tr>
<td></td>
<td>Operations and behavior of employees influenced by managers</td>
</tr>
<tr>
<td></td>
<td>Little conflict between ownership and control</td>
</tr>
<tr>
<td>Organization and empowerment</td>
<td>Flat with short decision making chain</td>
</tr>
<tr>
<td></td>
<td>Low degree of specialization</td>
</tr>
<tr>
<td></td>
<td>Corporate mindset, easier to share a vision</td>
</tr>
<tr>
<td></td>
<td>People dominated with few interest groups</td>
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<tr>
<td></td>
<td>Flexible organizations and flows</td>
</tr>
<tr>
<td></td>
<td>Training and staff development is more ad hoc and small scale</td>
</tr>
<tr>
<td></td>
<td>Informal evaluation, control and reporting procedures</td>
</tr>
<tr>
<td>Flexibility and innovation</td>
<td>Activities and operations not governed by formal rules and procedures</td>
</tr>
<tr>
<td></td>
<td>Low degree of standardization and formalization</td>
</tr>
<tr>
<td></td>
<td>Negligible resistance to change</td>
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<td></td>
<td>High incidence of innovativeness.</td>
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The literature review had three aims: to learn about the ISO, EMS in SMBs and theory related to implementing operational controls at facilities. Publications within the ISO family as well as national publications related to ISO standards form the basis of my literary search, as they state what needs to be fulfilled. Documents published in some journals, newspapers, Internet material, current reviews and scientific articles have been read to attain necessary knowledge to understand and grasp the EMS as a whole. By studying project management and organizational theory I found basic understanding of the way in which a project such as the implementation of EMS can be carried out.

Overview & Rationale

The literature published on Environmental Management systems is substantial and includes the ISO 14001 standard with papers, journals and books covering EMS development, evaluation and review.

However, there is a shortage of academic literature that critiques ISO 14001 or provides practical evaluations about the implementation of an EMS in small and medium businesses. Much of the existing literature on ISO standards is of descriptive nature and is limited to large organizations. Also the literature sources that do exist provide little insight into how to initiate an EMS.

Consequently focus of the literature review was to identify:

1. Necessary steps to build an EHS management system
2. The guidance that exists for each step
3. What type of organization the guidance is provided for; and
4. What additional resources are available to help with this work.

The project started with a study of the literature to find out what models already existed for environmental management in SMBs. The idea was to find out whether anyone had attempted to focus on these areas or not. Due to connection between implementation of standards in large organizations and SMBs it seemed appropriate to begin the study on practices carried out at large businesses, common features with ISO 14001 and Environmental management and different approaches to its implementation in SMBs. The approach and choice of exploration method were adopted in order to reach the objectives of the study, given the time factor and other limitations.

What is out there?

The number of published scientific studies that dealt with environmental management in SMBs and focusing on operational control is extremely limited. The small number of studies available has been natural considering that EMS is a relatively new phenomenon in SMBs and that the process of EMS implementation takes some time.

To address the current problem, the literature available describes ISO 14001 not only from structural perspective but also detailing elements including organizational dynamics like change management and training programs in large organizations\textsuperscript{19}. Some research work carried out in European countries like Sweden have explored and documented some part of their implementation process.
Categorization of Data:

There is a growing body of literature on the Environmental Management systems (EMS) but little emphasis has been put on the role of EMS with regard to its potential for driving companies toward eco-effectiveness. Effectiveness here means “doing the right things” in order to reach absolute environmental performance improvements\(^20\).

The data available is distinguished among three different categories: preconditions, activities and results of EMS. With regard to preconditions of company environmental exposures data is collected and the motivations for implementing an EMS are defined. With regard to activities undertaken, measures taken in three different areas are surveyed; the area of operation; management and organization; as well as products. And with regard to results, the environmental and economic performance related to EMS is available\(^21\).

The data collection process proceeded in three phases. First the case studies performed on certified companies outlined the main variable of the study. Second by reviewing the literature, measurement scales were developed. Finally, the questionnaire was prepared and presented to a group of industries. A single informant was used for each company; the respondent was knowledgeable about the ISO process\(^22,23\).
BACKGROUND:

The International Business Food Chain

Unlike their European counterparts, most small and medium size U.S. companies do not consider themselves to be part of the international business “food chain” and consequently see little reason to invest in the costly and labor intensive development and implementation of internationally recognized strategic environmental management systems (“EMS”) like the one specified under the International Organization for Standardization’s ISO14001 EMS Standard. Traditionally environmental management has been an issue mostly for big enterprises. The big corporations have the necessary resources to hire specialized people in order to address environmental matters, and have seen environmental management as a way to deal with environmentally related problems and as a way to communicate to concerned stakeholders that environmental matters are dealt with in a serious way.

As environmental performance in big enterprises has improved considerably in recent years, more and more attention is being paid to the smaller firms. Although small in size, their great numbers make their accumulated environmental impact significant. Moreover, small businesses often have low or no awareness of environmental matters and therefore the potential for improvement is significant.

Governmental Recognition and Incentives

On a second front, governmental agencies have begun to provide benefits to companies
that do have ISO14000-style EMSs. For example, Connecticut Governor John Rowland has signed into law "An Act Concerning Exemplary Environmental Management Systems" promising expedited permit reviews, reduced fees, less frequent regulatory reporting, a facility-wide permit for all approvals, and public recognition for companies that implement acceptable environmental management systems. EPA requires companies to have EMSs in place as a prerequisite to participation in any of its voluntary programs. EPA also has a policy of waiving punitive fines for companies with environmental management systems that, in the process of conducting an environmental self-audit, discover they are in violation of environmental law. New York State has a similar policy for small NYS businesses25.

Efficiency and Economics

Finally, the positive correlation between implementing an operational control and reducing pollution, increasing production efficiency, and avoiding unnecessary regulatory fines, fees and assessments in larger organizations is well evidenced in the professional literature. Progressive companies have embraced the concept of pro-active pollution prevention, sometimes called "source reduction," to reduce pollution by addressing the problem over the life cycle of the product or service. The continual improvement element of the ISO 14001 EMS fosters such improvements at all stages of the life cycle26. An effective operational control at an organization will help in controlling environmental problems and eliminating them, saving money by reducing waste, increasing efficiency, and potentially reducing the costs associated with environmental compliance and liability27.
The Monroe County Strategic Environmental Management Initiative (MCSEMI)

Mission

Most small and medium size businesses that do recognize the benefits associated with strategic environmental management are yet daunted by the complexity of the implementation process and the cost of bringing in the expertise necessary to make it so. The intent of the MCSEMI program is to assist small and medium size businesses in Monroe County by providing appropriate training and guiding them through the design, development, and implementation of strategic environmental management systems.

Scope of work:

The work described in this report represents one portion of the overall scope of the MCSEMI project. The focus here is on how SMBs develop and implement operational controls as part of a strategic environmental management system. The objective is to identify "best practices" for developing and implementing operational controls in SMBs.
CHAPTER III

METHODOLOGY
METHODOLOGY:

(Adopted in part with permission from Morelli, J, ISO 14000; A catalyst for reinventing EPA, doctoral dissertation SUNY ESF, 1996)

There are a small but growing number of individuals in small organizations that are engaged significantly in designing, developing, and implementing a strategic environmental, health, and safety management system. Consequently, surveys or surficial sampling efforts are unlikely to produce a significant body of data. Additionally, surveys do not easily capture an understanding of individual and organizational motivations, reactions and dynamics, elements that are fundamental to thorough analysis and successful prediction. Clearly, qualitative research methodologies was most suited to this investigation, and among them, the in-depth, semi-structured interview produced the best results as this method allows the interviewer to explore areas in which the interviewee has a greater depth of knowledge and avoid wasting time on areas in which he or she does not. This was especially useful in seeking to verify, validate or solicit comments on data obtained from other sources or to test hypotheses developed by the researcher.

Limitations of this Methodology

- The “facts” represent only part of the picture. Since so much of this development is new, soft, and sensitive to feedback, the extent to which the decision-maker “believes” that what he or she is doing is the right thing to do at this time influenced its chance of success.
• Second, since the perceptions of each individual are shaped by a different set of factors, interviews provided an opportunity for the interviewer not only to identify these influences but possibly to make some assessment regarding their relative strengths.

**Sampling Strategy**

An effective sampling strategy in this situation was to begin with identifiable (through a review of the literature) accessible key individuals and in every interview, include reconnaissance questions (e.g., Is there anyone else that you think I should talk to about this? Would you introduce me to this person?). This sampling strategy is known as snowball sampling and its strengths lie in its effectiveness at identifying individuals and organizations central to the research and in identifying social networks associated with the topic being investigated. In this way, the sample interviewee list grew (snowballed) over time toward more and better information sources. When additional significant resources were no longer being identified, this provided a useful indication to the researcher that field research needs are satisfied.

Organizations that were investigated included small and medium business (SMB) already ISO14001 certified; large organizations involved in assisting SMB; SMBs interested and/or in the process of developing an EHS management system. Individuals that were interviewed within these organizations included corporate-level officers, managers, auditors, environmental directors, and other participants in the design, development, and implementation of EHS management system and operational controls. Relevant individuals like safety officer involved in ISO leadership were also interviewed.
Protocol and Logistics

Study subjects were approached in the following manner. The researcher (ER):

- Prepared for the interview by researching information connecting the interviewee (EE) with the research topic;
- Called the EE and briefly explained the ER’s status as an M.S. candidate in RIT’s Environmental, Health, and Safety Management program;
- Stated the ER’s interest in interviewing the EE and explained the interview process;
- An introductory letter was sent to the EE with an attached resume;
- Followed-up with a second call established the time and date of the interview.
- Offered to provide EE with summary information on the finding of this work.
- Letter of thanks was sent to EE.

Human Subject Protection

The ER:

- In advance of the interview, each EE was provided with a written statement introducing and providing the rationale for the research project, and describing the semi-structured interview procedure to be used by the ER;
- In advance of the interview, each EE was provided with background information on the ER;
- Before beginning the interview, permission was requested to record the interview on audio tape for sole purpose of enhancing the ER’s note-taking ability;
It was explained that any part of the EE's response will be kept confidential or off the record;

EE had right to turn off the tape recorder at any time during the interview, or not use it at all;

EE was shown how to shut off the tape recorder and the recorder was placed within the EE's reach;

Audio tapes were kept secured and inaccessible to others outside of this study;

Audio tapes were erased after the ER was through transcribing and analyzing their contents

**Coding & Analysis**

Coding is central to developing analysis\(^{29}\). It is a process of identifying data elements in terms of where and why they relate to the topic under investigation. It provides a means of tagging data elements so that they can be pulled back together to provide a researcher a theoretical building block, to substantiate a theory, to refute one, etc. There are two basic steps in coding:

1. Tagging the data element with one or more appropriate codes; and
2. Placing the coded data element into a corresponding file where other like-coded elements exist\(^{30}\).

Each of these steps involves analytical elements. Determining an appropriate code for a data element requires the researcher to develop some understanding of what the datum is and what it represents. Filing it requires a determination of fit, and can result in a fine-tuning of the category description or, if warranted, in the creation
of a new category. Obvious categories for coding an interview text could include an individual’s title or position, the category of organization he or she represents, identification of the question being asked, etc. Codes to categorize responses to interview questions and text extracted from archival sources were developed during analysis. To begin, interview data was segregated by question, and arranged and coded across the range of responses in each area. Archival text was coded to indicate support or dissention with respect to the responses.

The Constant Comparative Method (CCM) of data analysis was conducted concurrently with coding efforts. Following the process developed by Glaser and Strauss, data categories were developed and defined as discussed above. As category definitions are fine-tuned and strengthened, relationships among them were discerned and used as building blocks for theory. As additional data elements had little to add, major themes were documented. CCM was used to organize text and to develop an initial hypothesis, which then was developed further and strengthened using the more rigorous Negative Case Analysis methodology (NCA). CCM/NCA analysis was supplemented and supported by triangulation using multiple-use interview and multiple-source data texts. Additional discussion on analytical methods is included in the sections on Reliability and Validity below.

Coding to ensure good housekeeping of data coincides with the activities described under Reliability below.

Reliability
The reliability of a research effort is a measure of the consistency of the results when a research instrument is used repeatedly in the same way to evaluate the same event. Inconsistencies in the application of research methodologies pose the greatest threat to reliability in qualitative research32.

In “Interpreting Qualitative Data”, David Silverman addresses reliability in qualitative research observations, texts, interviews and transcripts33. With respect to observational studies, he recommends, among other things, that notes be systematized to avoid inconsistencies and that expanded notes be made as soon as possible after each field session in order to avoid or minimize errors that could arise from later misinterpretation of notes, particularly when trying to make distinctions among verbatim quotes, paraphrases and contextual interpretations. Concerning the analysis of existing texts (i.e., prepared bodies of data), he alerts the reader that a lack of ‘inter-rater’ consistency among analysts of the texts will lead to inconsistencies and consequently produce unreliable results. He identifies interview reliability as a central issue in qualitative research and highlights the importance of consistent interview schedules (i.e., sets of interview questions, prompts, etc.) and consistent understanding of the questions by the interviewees. To achieve interview reliability, he again recommends ‘inter-rater’ reliability checks as well as interview schedule testing, interviewer training, and maximum use of fixed-choice answers. Finally, Silverman identifies transcripts of audio recordings of interview sessions as satisfactory for ensuring transcript reliability and documenting data collection procedures. Each of these recommendations are presented and discussed below with respect to their application to this research.
Systematize note-taking conventions.

In order to eliminate or minimize contextual misinterpretations, an attempt was made for all interviews conducted for this research to be audio taped. Correspondingly, field notes were taken to identify body language and gestures that may impart additional meaning or understanding to the text or to highlight topics that need to be revisited either during the interview or in connection with other sources that corroborate or challenge the text. Simple abbreviations were used, when needed, to describe gestures or facial expressions associated with specific topics that appear to convey. Verbatim transcripts of audiotapes were prepared using systematic conventions to delineate contextual variations.

Expand notes as soon as possible.

The interviewer reread the field notes as soon as possible after each interview and elaborated upon areas needing additional detail. Strategies that worked well or that did not work were identified. The interviewer transcribed audiotapes and annotated transcriptions with field notes, comments and references to other corresponding text within 48 hours or less. If transcription was not possible within one week of an interview, the interviewer replayed the tapes and took additional notes elaborating on any areas that might have become confusing with time.

Performed ‘Inter-rater’ reliability checks.

analysts, amplified and enhanced each of the strategies described above.
➢ Maximum use of open-ended strategy.

➢ Developed and implemented a consistent interview guide.
Interview Guide

1. Given the list of significant aspects how do you set your corresponding objectives and targets?

2. Who is responsible for identifying the operations and activities that are associated with significant environmental aspects?
   - What are the criteria for appointing this person?
   - Who is involved in planning the controls?

3. Do you ask your suppliers and contractors about significant environmental aspects?
   - Do you ask them to recommend controls?

4. What procedures did you take to identify or develop these operational controls?
   - What operational parameters were the controls based on?
   - What alternatives did you consider, what were the basis for the consideration?
   - How do you develop/identify performance indicators? Give some e.g.
   - How often is it measured and what are the conditions?

5. What type of operational controls you have at the facility?
   - Are they, Administrative, Technical, Combination or some other?

6. Who monitors these controls you have at the facility?

7. Do you consider technology change as operational control and is maintenance identified as a part of you operational control, and if yes then how?
   - Can you give an example?

8. How do you identify the need for operational control on new products, processes, or services?
   - Is it a part of risk assessments for new processes and projects, do you identify operational controls?
   - Does the EHS representative approve the assessment?
   - Do you update your operational procedures when new products or processes are introduced?
   - How do vendors contribute in providing information related to operational control?
Strive for consistent understanding of the questions by the interviewees.

To the extent possible without significantly impeding the natural flow of information, the interviewer followed the prescribed interview schedule. However, while a standardized open-ended interview format including previously prepared questions is advisable for interviewees with limited available time⁴, as was likely to be the case in much of this work, the interviewer considered how each individual interpreted the questions being asked. Understanding of a question varied from one person to the next depending upon how a person “sees” the world and perceives the motives of the interviewer for asking the question. This created a dilemma for a researcher interested both in a consistent understanding of the question, and in the interpretative differences among the interview subjects. The interviewer considered this information in preparing for each interview, but the emphasis remained on providing interviewees with a consistent understanding of the questions. In cases where such consistency was inappropriate (e.g., that forced the interviewee to respond in a manner inconsistent with his or her own vision or understanding), or impossible (e.g., because the interviewee did not respond to the question as asked), the interviewer attempted to determine the basis for this aversion.

Establishing rapport, imparting a sense of trustworthiness, and creating a context for expressing feelings, opinions and communicating knowledge and opinions early on in the interview was helpful in engaging the interviewee⁵. Toward this end, the interviewer initiated each interview with a casual, candid and value-neutral description of the purpose for and nature of the research, and with a fairly general, non-controversial first question
prefaced by a narrative describing a relevant and historical event and establishing a context for the response.

When additional areas of inquiry or area-specific issues were uncovered the researcher then decided to add to the interview schedule for subsequent interviews, these additions were, to the extent possible and reasonable, positioned in the question sequence so as to minimize the disruption of the information flow in the original set of questions and probes.

- Document data collection procedures.

Taken together, the research guide, audiotapes and field notes adequately document data collection procedures.

**Validity**

The validity of a research effort is a measure of the extent to which the findings and conclusions of the work accurately explain the activity under investigation. Also, it asks whether the right thing is being measured. Validity of qualitative research data was established by carefully and incisively identifying and evaluating competing interpretations of the data. Lindolf provides four proven methodologies involving this strategy: Triangulation, Negative Case Analysis, Member Checks and Quitting the Field. Each is presented below and discussed with respect to their application provided to this research.

- Triangulation
This method compares multiple sources of information about an object of inquiry. Data was derived from multiple use of a single method (e.g., in-depth interviews), single (or multiple) use of multiple methods (e.g., interviews and examination of archival texts), and by the use of multiple investigators. Triangulation provided both a credible means of verifying data and of developing concepts. The use of multiple methods is the most common approach to triangulating research text. In the most common approach (i.e., multiple methods) explanations derived from one method, from among those employed, were then enriched or qualified by text generated using complementary methods. Although multiple-investigator methodology introduces additional variables to the study, it was used to take advantage of the strengths and to compensate for the weaknesses of individual analysts.

Silverman argues that attempts to develop and validate explanations by aggregating data taken in different contexts ignore both the 'skillful character of social interaction' (i.e., does not recognize the fact that different methodologies can elicit different responses to what essentially may be the same question), and the differences in boundaries imposed by each methodology\(^36\). He suggests that this concern can be addressed by triangulating methods and data only to the extent that they focus on the understanding of why an event is occurring rather than how.

Multiple-use of in-depth interview methodology and use of multiple-methods (i.e., in-depth interviewing and examination of archival text) were applied in this investigation as the principal strategies for validating this work. Alternating between these methodologies provided the researcher with opportunities to identify essential information sources, refine investigative strategies and verify data. Analyses of areas of
convergence were directed towards understanding why, rather than how events were occurring.

- Negative Case Analysis (or Analytic Induction)

Negative case analysis is an iterative process in which a hypothesis is formulated, then tested by applying it to a case or to data generated during the research, modified as necessary to accommodate the data, tested against new data, modified again, tested again, and so on until a universal relationship is developed. Silverman suggests that in qualitative research, analytic induction replaces the quantitative function of statistical testing; since hypothesis development continues until all the data fit, random error variance is eliminated and statistical analysis becomes unnecessary.37

Both Lindlof and Silverman identify Glaser and Strauss’ Constant Comparative Method (CCM) as appropriate for developing the initial hypothesis for use in Negative Case Analysis (NCA). Glaser and Strauss differentiate between the two methods by making the distinction that CCM is used to develop, but not prove, a plausible hypothesis about a general problems, and NCA is concerned with developing and proving a universally applicable theory about a specific behavior.38

In this research, both methods were used, as suggested by Lindlof and Silverman, for initial development of a plausible hypothesis, and NCA for further refinement and verification. Since the outset, development of this proposal has involved an evolutionary process resulting in several significant adjustments both to the lead research questions
and to the conceptual area of inquiry itself. Much of this is attributable to the researcher’s need to narrow the conceptual area of inquiry to a manageable topic.

In this study, the researcher’s initial observations revealed a perceived need for a decision-making model for SMB’s to use in determining an appropriate level of operational control.

- Member Checks

While warning that no one member of a culture is fully informed about his or her culture, Lindlof suggests that member checks can be a useful way to test or validate hypotheses, explanations or interpretations presenting them to members of the culture.

Member checks were used in this work to test a particular interpretation or explanation or simultaneously as a prompt to determine a response to a proposed hypothesis.

- Quitting the Field

When new data are consistent with the hypothesis or explanation, require no modification and provide no new surprises, the study has reached a point of theoretical saturation. It is time to review what has been done and end the project.

This work ends when a point of diminishing returns is reached to the extent that new information duplicates what already is known and no significant modification to the hypothesis or explanation is required.
**Research Study:**

The aim of the thesis was to study approaches to operational control management system implementation, and determine the best approach or approaches that could lead to the development of operational control in a company. These finding would then be used to develop best practices in implementing operational control at SMBs.

**Approach and Exploration Method:**

The approach and choice of exploration method adopted in order to reach the objectives of the study, included a review of the literature and in-depth interviews of EHS professionals and others in small companies. A number of published studies were explored in United States and Europe that had data and documentation on implementing controls in small and medium businesses.

The main steps were:

1. Conduct a number of interviews to gain knowledge, especially concerning the area of implementation of ISO 14001
2. Collect and read literature to get a good overview of the area.
3. Using information gathered in step 1 and 2 make a more detailed problem definition and formulate research questions.
4. Research literature and conduct interviews to gain more knowledge on the models used to facilitate implementation of operational controls in SMBs
5. Use the information gathered to formulate questions and conduct a number of interviews with certified companies.
Collection of Data

Data has been gathered in two main phases:

**Phase 1** – Gather data regarding a) EMAS and ISO 14001; b) Small and medium businesses certification and EMS implementation; c) Different models used to ease the implementation and certification of EMSs in SMBs.

**Phase 2** – Conduct a number of in depth interviews with personnel’s who were involved in certification process and were well experienced in this process.

Collection of Data during Phase one

During phase one data was collected through:

- Literature on environmental management in the form of books, articles and brochures.
- Information available on Internet.

Collection of Data during Phase two

During phase two, the information from phase one was used to formulate a number of questions, in order to perform a limited qualitative study, with in depth interviews with experienced employers in order to find out:

a) The current pressure on small and medium companies in obtaining EMS certification;

b) To what extent big companies mentored these programs to help their suppliers;
c) Whether different types of SMB's had different problems in implementing operational controls at their facilities.

d) Whether the existing EMS standards are suitable for small companies and if they can suggest any alternative ways for small companies to show that they have an environmental performance.

e) Their opinion on different models used to ease implementation and certification of EMS in SMB's

f) If they think that the operational control that are implemented in small companies are suitable for companies needs

Since the interviews were in depth, many follow-up questions were asked during the interviews and interviewed persons were allowed to go into details. A small number of rather extensive, in depth interviews were chosen as the method, instead of sending out large number of questionnaires.

**Limitations**

Those facilities included in this study:

- Registered as Small and medium manufacturing companies only in NY State in United States

- Have at least one employee apart from the owner.

The study refers to individual companies activities. That is, the selection criteria covered facilities and not the entire companies. The survey group constitutes of total 11 facilities.
Method for selecting companies studied

About 30 SMB’s were sent letters and questionnaire and were requested for interviews. Facilities selected were based within the New York State (US). The choice of companies was based on availability rather than other criteria. The Prestudy was broad and its purpose was to sharpen the focus for the research questions for the main study and to learn more about the company processes and interview techniques in 11 different types of industries. These companies had implemented EMS so questions were focused on their experiences they had in implementation process and possibilities to connect management system for health and safety too. A further goal was to understand connecting between systems and to gain results that could be generally applied.

The Main Study:

The number of published scientific studies that dealt with environmental management in SMB’s is extremely limited especially for operational control. The small number of studies available has been natural considering that the EMS is a relatively new phenomenon and that the process of EMS implementation takes some time. The results as well as findings in literature were used to discuss the possible implications on implementation of operational control and were used to design the research guide. The main sources in the information search for the study were relevant experience on the part of the researcher, different scientific article summaries and full text databases, for example EBSCO Online full text via the Library at Rochester Institute of Technology on the Internet.
Case studies found on Internet made it possible to gain more holistic\textsuperscript{39} insight into the implementation process at the case companies. These companies tended to take into consideration a wider array of materials and aspects rather than focusing on the planned EMS implementation process. All cases were described and analyzed, combining them to form the theoretical structure of the study (SMB→EMS→Operational Control)

The selection of the companies was based on the availability of SMB’s in the region. They were private, local companies which had less than 200 employees had implemented EMS and which made them interested in participating in the study.

In Depth Qualitative Interviews:

A) Selecting Participants –

Since interviews were time consuming to conduct and analyze, and there were limited resources only a few number of people were interviewed. Organizations were carefully selected for their expertise in implementing ISO 14001. At the start of interview only those individual were selected who presented “the big picture” so that all of important topics were identified. Use of multiple respondents was more appropriate here: first, an effective environmental strategy requires function integration, in particular production and, second data obtained from different informants is more reliable\textsuperscript{40}.

b) Number of Interview Conducted –

The sample consisted of 11 companies and all of them were privately owned SMB’s selected on ground of proven record in environmental management. Companies were included on the basis of participation and recognition in number of environmental
initiatives. The sectors represented by these companies include chemicals, printing, packaging, fabricated metal products, electronic products.

The interviewees were the companies EHS managers, plant managers, and quality people, meaning any individual who was involved in implementing EMS and were a substantial part of his/her job responsibilities. The interview route was selected rather than survey methods, as the research was exploratory in nature. The interviews can be described as semi-structured. The respondents were presented with a menu of choices for some questions, but also ‘options’ to give additional other information or comments.
CHAPTER IV

RESULTS AND ANALYSIS

NOTE: This chapter contains data obtained from the interviews conducted with eight representatives from the following industries – Two electroplating industries, ink industry, plastics industry, beauty products industry, magnetic materials industry, turbine industry, and waste energy facility.

The name of the companies and individuals interviewed are kept confidential.
In this chapter the consolidated responses to each of the research question on various activities as part of operational control are presented.

The operational control element serves as a key focal point in environmental management. Operational control can include: administrative or managerial controls; technological or engineering controls; training and education; material substitution, process changes and products changes or discontinuance. The ISO 14001 EMS standard requires an organization to document operating procedures associated with its significant environmental aspects, develop objectives and targets and then implement proper controls. Research showed that these procedures stipulate operating criteria. That is, the procedures or work instructions needed to guide personnel in the correct execution of the task if failure to do so could result in bad outcomes. These outcomes would include breaching laws or regulations, failing to prevent pollution, or violating the organizations environmental policy or its environmental objectives.

For example, oil and gas platforms operators rely upon compressors to move product through pipelines at uniform rates of pressure. In addition to playing a key role in production, oil field compressors are associated with the potential for significant environmental impacts, such as releases of oil or gas to the environment. The compressors require scheduled maintenance as part of operational control to ensure their suitability for continued service. The operational control element of ISO 14001 ensures that organizations plan such controls and carry out activities under controlled conditions.
Case 1: Given the list of significant aspects how do you set your corresponding objectives and targets?

In this question author wants to identify and understand the inputs, processes, and participants in setting objectives and targets. To see how policy might influence these choices.

Definitions:

"Objective": An overall Environmental goal, arising from identification of significant aspects and the environmental policy, that an organization sets itself to achieve, and which is quantified where practicable.

"Target": The Detailed performance requirement, quantified where practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

Objectives are long-term (i.e. one to three years) goals and targets are short-term (up to one year) goals. Targets generally vary throughout the various functions in an organization depending on the activities, products or services.

Criteria for Objectives & Targets: What should be considered?

In answering this question, majority of interviewees stated that good planning was the basis for implementing a functional and worthwhile EMS against ISO 14001 standard across all the companies. Organizations did their homework well in advance before
starting the process. Aspects and impacts were studied in detail before the team took appropriate planning steps to identify the objectives and targets.

Setting environmental objectives and targets initiated the implementation process; it was at this point that specific plans for improving environmental performance were set in motion. As stated by the General Manager at ink industry "By setting objectives and targets we looked into regulatory aspects of the place; where we stand now and where we want to be in future to find the root cause as it pays off in the long run". The decisions were taken based on the regulatory requirements and the requirements from the top management with views from interested parties.

All organizations performed a baseline evaluation of current and past activities, products and services. The main purpose of the evaluation was to establish a general framework for the identification and evaluation of environmental aspects and impacts at the facility with which corresponding objectives and targets were set. Identification of environmental aspects was done systematically, the team sat down and whoever was aware of the processes generating waste streams, or risks in the processes brought to the attention of other team members. This was the criterion for industries to list various environmental aspects which was then related to objectives and targets

The activities, products and services identified were organized according to following functional areas:
Significant Environmental Aspects: All the significant “aspects” or activities or products that created a probability of impact to environment were considered at the time of setting objectives and targets as these were most vulnerable areas.

Manufacturing Process – Activities, products and services that were integral to organizations finished products.

Legal Issues – Existing environmental issues that were direct result of past plant operations were identified and considered at a higher priority.

Objectives and targets were set for every department/function with significant aspects. Environmental impacts that were taken into consideration in identifying which aspects were significant also played an important role in setting corresponding objectives and targets.

One of the General Manager claimed that once the significant aspects were identified they were used as the basis for setting corresponding objectives and targets. They came with a table, which was based on four critical factors:
Table 4.1: Critical Factors for Identifying Objectives and Targets

<table>
<thead>
<tr>
<th>STRATEGIC ISSUES</th>
<th>ATTRIBUTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory Requirements</td>
<td>Implementing comprehensive aspects programs greatly improved a company’s regulatory compliance program</td>
</tr>
<tr>
<td>Technological Aspects</td>
<td>Environmental specialist assistance, Monitoring and measuring equipment, Production process enhancement</td>
</tr>
<tr>
<td>Economic and Business Requirements</td>
<td>Aspects that allowed efficient identification of opportunities for cost savings or in other words that triggered procedural or technological changes reduced total cost of product and improved its value.</td>
</tr>
<tr>
<td>Team and Management Opinions</td>
<td>Top management commitment and support, Team reviews, Appropriate environmental policy, Regular management reviews</td>
</tr>
</tbody>
</table>

“Our proposed objectives and targets link the expressed environmental concerns of the community with environmental impacts identified as being associated with the department’s services and operations. In other words, our objectives are an expression of what contribution the department will make towards achieving larger community goals.”
Developing Objectives and Targets from the Environmental Policy Statement

About 30% of the interviewed small and medium size businesses wrote an environmental policy and based on this policy established their objectives and targets. These objectives were the broad overall goals for the environmental performance identified within the context of the environmental policy. Companies identified and reviewed their environmental practices and policies to set objectives and targets. The objectives and targets reflected health, safety and environmental policies of various groups as these activities assessed, monitored and controlled all risks to the environment and ensured that plant and equipment’s operate in conformity with standards. As stated by the Environmental chemist at an electroplating industry “Basically what we did is we wrote an environmental policy, we took the policy and we numbered the statements in the policy, there were 15 statements in the policy which became our objectives, and below each objective statement we listed their respective targets."^{44}\)

Most of the SMB’s used this approach to identify their objectives and targets. The policy established the framework from which environmental action followed. Having identified the objectives specific measurable targets were set with appropriate time schedules. This provided a means of continuous improvement and gave institutions ability to respond to developments both within the institution and on environmental front in general.
Deciding the Time Limit:

Once the objectives and targets were derived and recorded only two to five were chosen at one time. Some facilities reported that it was extremely difficult to work on all of them in the initial stage hence only one or two out of the given number were given priority. The Environmental Coordinator for objectives did monthly reviews and evaluated programs towards target and this was discussed in the monthly meeting with the committee members to review the progress. The committee also decided whether date set to achieve the target needs to be extended.

Once the objectives and targets were established the operational and financial limitations of the business were evaluated, the ranges of operational controls were thus limited. Depending on the size and the funds available for establishing controls the process was started and few projects were taken at a time with completion time goal for each.

Couple of businesses developed a template that listed aspects, objectives, targets, responsible party or individual for completion and completion date. Objectives and targets were considered projects instead of programs. Objectives were given step-by-step approach and a specific target time was set for completion. Following is a sample table for identifying aspects, objectives and target with the responsible person in charge of that operation.
**Table 4.3: Environmental Aspect, Objectives and Targets**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Objective</th>
<th>Target</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Waste Generation, Management and Disposal</td>
<td>To reduce non hazardous waste (paper, cardboard, food)</td>
<td>75% reduction by 2005</td>
<td>Joe Romano</td>
</tr>
<tr>
<td></td>
<td>To reduce hazardous waste (chemicals etc)</td>
<td>40% Reduction by 2005</td>
<td>Rick Ditch</td>
</tr>
<tr>
<td>2) Energy and Fuel Usage</td>
<td>Reduce energy consumption through life cycle cost effective measures</td>
<td>Reinvigorate energy management program</td>
<td>Tom Alter</td>
</tr>
<tr>
<td></td>
<td>Reduce annual petroleum consumption for vehicles</td>
<td>Reduce consumption by 20% by 2005</td>
<td>Robert Duke</td>
</tr>
<tr>
<td>3) Hazardous material consumption</td>
<td>Reduce amounts of material received, stored at facility</td>
<td>Reduce hazardous material inventories/storage by 20% by 2004</td>
<td>Rick Ditch</td>
</tr>
<tr>
<td>4) Air Emissions</td>
<td>To reduce use of ozone depleting substances</td>
<td>By year 2005 replace 100% of chillers greater than 150 tons of cooling capacity</td>
<td>Robert Duke</td>
</tr>
<tr>
<td></td>
<td>To reduce green house gases</td>
<td>Reduce generation of greenhouse gases attributed to facility energy use through life cycle effective measures by 25% by the year 2007</td>
<td>Tom Alter</td>
</tr>
</tbody>
</table>
Prioritizing significant objectives upfront -- coming up with Rating Scale:

Once the significant aspect were identified the organizations went into certain degree of facility awareness and processes and a rating system was derived by almost all of them scoring points varying form 1 to 10 in terms of severity or highest significance.

“We stated that we are going to take those aspects that have high numbers. Once they are done we take the next highest so that we are continuously working on down the list of significant aspects, we moved forward with the system, say we took our significant and developed controls in terms of rating and then we take the next highest, this can be considered one of the links we have between our policy statement, continual improvement and pollution prevention, looking at the highest rating.45”

“As we ended up with so many objectives and targets we had to prioritize them by coming up with a ranking system, we put numbers in there and we totaled the rankings up for each of those targets and we sorted the whole list of targets and brought the highest rankings to the top and that gave us a group of targets to achieve.46”
IMPACT RANKING KEYS:

For all significant aspects organizations designated the magnitude of impact by using rating scale. One of the scales developed by Electroplating industry is presented below. In some cases the cause was obvious however sometimes the root cause of the problem was not the obvious cause.

Table 4.4: Impact Ranking Keys

<table>
<thead>
<tr>
<th>Environmental Impacts:</th>
<th>Business Factors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – No Impact</td>
<td>0 – No value</td>
</tr>
<tr>
<td>1 Present, But Negligible impact</td>
<td>+1</td>
</tr>
<tr>
<td>2 – Low impact</td>
<td>+2 – Low value</td>
</tr>
<tr>
<td>3 – Moderate impact</td>
<td>+3</td>
</tr>
<tr>
<td>4 – High impact</td>
<td>+4 – Moderate value</td>
</tr>
<tr>
<td>5 – Non-compliance</td>
<td>+5 –</td>
</tr>
</tbody>
</table>

Employees from all parts of the organization assembled to form an environmental cross cutting team and the team analyzed nearly all operations to determine objectives and their
relative targets. They evaluated and ranked each objective using the above mentioned method and came up with “Top 10 list”
Case 2: Who is responsible for identifying the operations and activities that are associated with significant environmental aspects?

The relevancy of this question is to determine the responsible person/team associated with the EMS process that helped in identifying the processes and activities within the facility that might be significant and result in an impact.

Definition: The ISO 14001 standard uses the term “operations and activities”, in a broad sense to apply to all functions in the organization, i.e., it applies not only to the manufacturing operation itself, but also to a broad array of business processes including design, purchasing, engineering, construction, maintenance, production etc.

The companies had established various working groups that consisted of expertise from their respective field. They called these groups “environmental committee” and had members from various operating units of the department like engineering, production, health and safety etc.

These working groups were asked to identify:

- Current Responsibilities for developing the core functions – Trends and patterns were identified, characterized and analyzed so that effect on the performance can be fully understood. This focused on areas of processes that resulted in most defects (injuries).
- The positive and negative environmental impacts associated with the core functions and;
- Legal and other requirements that must be met in delivering the core function

This process required different skills hence people were selected from various backgrounds; they possessed some knowledge of environmental regulations and specialized in the field of compliance. They also had a strong understanding of basic manufacturing/production processes.

Although compliance and identifying operations are complementary processes, they require different skills within the team. Compliance officer possessed detailed knowledge of environmental regulations and specialized in his/her respective field. They had a strong understanding of basic manufacturing/production processes in the assessed facility and knowledge of good auditing techniques.

**Internal Team:**

The size of the team varied from four to eight people, and if the company already had quality systems in place same people were selected as they understood the system documentation, implementation and verification.

The internal environmental committees consisted of combinations of -- plant manager, senior engineer, human resources director, ISO 9000 coordinator, R&D manager, quality control manager, and the EHS supervisor. Data from 70% of the interviews showed that
quality systems manager and safety officer were part of the same team because of their expertise in implementing quality standards and process controls.

Internal team selected had a good understanding of environmental regulations and strong knowledge of environmental practices across their areas of working. They had strong understanding of how the process is managed and what practices are generally not effective.

Respective members of the committee worked independently and assessed their areas of responsibility; they also interviewed their subordinates to various environmental functions of the process. They interviewed employees, which involved critical examination of the operations on the site in order to identify areas for improvement to assist in meeting the EHS requirements.

Each member of the environmental committee was involved in identifying the significant aspect, “each member of the team gets involved from different areas of the plant and each person has their own insights to offer to the team related to their work area, they consider the new items or either items that have not been addressed properly in the past, so each team member comes up with their score stating what their opinion is what they have worked on and what their experience is in each of these items and then that is averaged. The board then came to a conclusion when we identified something as significant aspect we must have here a measuring or monitoring procedure, operational procedures”

The environmental committees used to meet for monthly management steering meeting to see if there are any changes to the ISO 14001 aspects and these were communicated across the board, this was an easy way to pass the information.
"Since I am the environmental engineer of the plant and this is the EMS I was involved, plant manager was a part of team as he/she had an idea of everything that is going on and is involved in day to day operation stuff. However the Decision makers were the highest level of management the team, this did not consist of lower level employees but they were involved in day to day activities that have a lot to do with the ISO 14001 compliance."

The EHS coordinator/Environmental manager was considered the best resource in this process, "In the process of doing this I sat down as I am being aware of the processes, waste stream we generate, risks, I did the walkthrough of the facility and in departments I talked with people and from there we established significant aspects" says Environmental manger of a Engineering Industry. They were sent to attend seminars, workshops, auditing training to familiarize themselves with the ISO standards and to get an overview of all the processes it involves.

The internal team had ability to effectively interact with wide range of personnel across the organization from senior manager to operations personnel. Operations were also examined to get a physical impression of the site and it environmental performance, this included a study of documents eg instructions and policies.

Consultants:

Consistent with good TQM practices many companies hired outside consultants to audit their operations and evaluate their programs. Here the consultants came in and assessed the companies operations based on environmental criteria that corporate developed.
Consultants helped some SMB’s in identifying activities associated with significant aspect as they were familiar with it and knew what applies and what does not apply.

Third party assessments were aimed at identifying operations and auditing facilities. These assessments were however directed at verifying/authenticating environmental performance of various operations. Consultants identified operations based on the requirements of ISO 14001 and focused primarily on the review and assessment of all the areas specified in Environmental Management system. Because of their experience they hardly took a day or two in identifying these operations. Their procedures were same as an internal team.

Many large corporations wanted their suppliers to be ISO 14001 certified and helped them in identifying the activities and were part of the steering committee, “I was primarily putting them out on the paper but I worked in the building with supervisors, managers, maintenance people and in walk around process we also had Xerox person who would walk in and helping us identify the activities and processes, basically consulting and prioritizing, more or less taking the role of a mentor in the process as we had been through with before, while we knew our processes the standard implementation is the place where consultants expertise helped us a lot49”.

“ When consultants come in they rape your system apart, they walk around they look at something coming in the door, who approves, who does that, how do you show them the documentation, and after two days they tell you where to begin50”

Accountability & Responsibility:
Responsibility for the overall effectiveness of the EMS was assigned to a senior person or person with sufficient authority, competence and resources, in most of the cases it was EHS coordinator. Sometimes Plant manager also shared this responsibility. The environmental committee clearly defined the responsibilities of relevant personnel and one possible approach for developing environmental responsibilities is presented below, however it was recognized that companies and institutions had different organizational structures and defined environmental responsibilities based upon their own work processes.

**Developing Environmental Policy:** Environmental Committee, President, CEO, And Environmental Manager

**Regulatory Compliance Issues:** Senior Operating Manager, Environmental Manager

**Continual improvement:** All Managers

**Comply and Defined Procedures:** All staff

At the time of assigning the responsibilities issues like performance, verification work affecting environment and sufficient training were considered.
Case 3: Do you ask your suppliers and Contractors about significant environmental aspects?

This question relates to establishing and maintaining procedures related to the identifying significant environmental aspects of goods and services used by the organization and communicating relevant procedures and requirements to suppliers and contractors.

Manufacturers that supply goods and products to companies and organizations are facing increasing pressure on every front from ISO certification point of view. Companies have found that they cannot successfully minimize the environmental impact without considering entire supply chain. That’s why majority of them have placed stringent demands upon the environmental aspects of product material and manufacturing processes, as they knew that they couldn’t reduce total environmental impact without their supplier’s cooperation.  

Findings:

Interviews showed that in order to establish commitment to environmental leadership all ISO certified companies had established relationships with environmentally responsible suppliers and required contractors to comply with all the applicable environmental laws and regulations in the work they do for company. Companies had now started focusing their efforts on reducing environmental impact of their entire supply chain; they identified substances and products like raw materials, chemicals, fuel etc. that
suppliers had to forgo. The companies directed their process for integrating sound environmental management throughout their supply services “We are interested in doing business with environmentally responsible suppliers and also believe that such registration can be of benefit to them. As it is a requirement stated in our companies operational control policy the suppliers have to sign a bond on the operational controls available for their products and machines. The contractors that come on the premises are trained as well and are aware of this bond”.

Ink Industry initiated a process of communicating with their suppliers and customers, they made it a policy statement that all their purchase orders and acquisitions must comply with local and federal, safety regulations certification made upon request

According to the interviewed companies, the first step is to begin with identifying significant environmental impacts and determining which of the organizations that supplied goods and services affect these environmental impacts. The group, which consisted of cross-functional team, worked on the identifying process; this included personnel from the purchasing department too - as they are familiar with the suppliers. The areas of concern included equipment, utilities, information, transportation, etc.

As the standard says the relevant procedures and requirements should be communicated to the suppliers and contractors, hence the requirements set for each supplier was related to the significance of the supplier’s environmental impact. For example the raw material supplier specifications focused on the impurities, here the supplier was required to notify the company before making any significant product or process changes.
Plant Manager or Environmental team while conducting businesses dealings with vendors came up with a list of their supplies and conveyed their message of greener products, they had also set this with solvents and chemicals collected and disposed by contractors, they mentioned this in their maintenance or service contract. Implementation of an EMS provided strategic value to business in its management of change in the direction of supply side, this allowed the development of a system approach for checking to see if certain supplies will be available in the near term and long term. It was seen that many of the suppliers to these companies that are ISO 14001 certified received a questionnaire that asked, “Do you have an EMS or are you considering developing an EMS?” One of the important framework conditions was the supply chain pressure and this became an important and significant driver in recognizing controls associated with products.

All the chemical manufacturers felt that auditing their supplier’s facilities would benefit them in identifying environmental aspects hence a pre-audit questionnaire was sent and facilities were audited, “We deal with very few contractors and suppliers we have purchase orders with, we have done the audit of their facilities, in fact we have done this before getting ISO 14001 certified, they are not highly structured audits the essential walk through, to have a general feel of the place53”. The suppliers for the turbine industry were also asked to get ISO 14001 certified, however the relationship with the critical were considered and sensible requirements were set.

As a result of EMS the turbine industry came up with particular supplier requirements:

Chemical and materials involved in products or services delivered had to meet the requirements stated in the company policy. “Our suppliers are aware of the policy statement, we initially had a communication letter that went out to all our suppliers that
stated our registration and our requirements, and we have a vendor approval process which they have to go through.53 “

Environmental data on processes used and products or materials supplied by contractors were made available and furnished upon request to enable environmental products assessment.

Three industries stated that the use of recycled materials and design for recycling principles were considered during the selection of materials and design solutions.

Ink and Electroplating industry asked suppliers to use design for environment (DfE) to minimize products environmental impact during its entire life cycle. Supplier had to declare in accordance to standards the material content of products delivered. They were also requested to prepare supply life cycle inventory data for processes and products. If possible they were to provide information about how end of life treatment of delivered material will be handled.

Suppliers provided information on environmental aspects of transportation services to the manufacturing facility like transportation type, packaging material, and production locations. The environmental performance in each stage of entire supply chain contributed to total environmental impact of the final product. This “cradle to grave” approach by SMBs required that the environmental performance of all members of the chain is known and effectively managed. This extended upstream along the supply chain to suppliers of components; going downstream this covered the use of product, as well as the eventual disposal or recycling of components or materials.

Conclusion:
Supplier shall recognize its environmental aspects, document and measure the environmental impact of significant aspects and have improvement programs for them.

This is one of the cornerstones of EMS, the programs covering the environmental aspects. The program targets here were defined in form of responsibilities and milestones. The programs varied from industry to industry but each supplier took into consideration its own environmental impacts.
Case 4: What type of Operational Controls do you have at the facility?

The relevancy of asking this question is to determine what types of controls are identified by the organization as part of Environmental Management Systems and how effective they are in achieving the assigned target.

Industries started planning processes that enabled them to identify operational requirements before work began hence ensuring environmental hazards were adequately controlled. They first considered engineered controls (i.e., double-wall piping), then administrative controls (ie, operating limits), and then protective equipment (i.e. adsorbents) to identify the appropriate operational controls for the hazard.

As the EHS manager for Mechanical Engineering company states: “There are mainly two types of controls technical and administrative. Administrative Control: We have a production meeting on a daily basis, we discuss aspects associated with the different processes/compliance and if there is a problem it is brought up at the meeting we think of how it can be set right and what can be done immediately. Technical controls are more prevalent because if there is a problem in producing a certain product it is usually technical by nature usually the administrative controls give a go ahead to fix the problem immediately and then does a kind of root cause analysis."

“All operational controls were already in place we only needed to codify them the procedures mainly, they were almost regulatory driven”
Experimental and routine operations were evaluated for hazards. Early identification of hazards and their mitigation was a proven technique adopted to minimize the risk of an impact, it assured environmental protection, and avoided unnecessary costs or delays caused by incidents.

*Administrative Control:*

EMS for ISO was primarily based on the organizational structure. The environmental Operations group normally set strategic direction for sites; this group was responsible for entire EMS process. Management review of the system was undertaken periodically by the Environmental operations group. Administrative controls consisted of:

- Environmental information, including audit results, trends, legal updates on process controls.
- Communication to site managers
- Yearly Self-assessment of controls by environmental operations group.
- Comparison of Management team reviews progress against environmental objectives and targets on an annual basis on the effectiveness of EMS.

Core team composed of site personnel for their respective areas put environmental effects into operational controls. Teams made sure that environmental content with procedures and programs are appropriate to EMS.

"We have a production meeting on a daily basis; we discuss aspects associated with the different processes/compliance."
Wherever possible the requirements of the EMS were built into existing processes or were to be designed in such a way that they could be merged with an existing system at a later date.

**Technical/ Engineering Controls:**

To implement technical controls the Environmental operations team evaluated four main areas of operational risk associated with industrial processes:

**Quality:** the risk of supplying a nonconforming product or service to customer.

**Safety:** the risk of damaging the environment during production, or providing an environmentally unfriendly product

**Environment:** the risk of damaging the environment during production, or providing an environmentally unfriendly product.

**Security:** the risk of criminal activity during production or provision of a service.

Environmental operations team complied with right-to-know requirements by:

- Identifying those hazardous materials used in their premises or by their operations to which controls may apply.
- Provided training on the hazards and safety procedures for specific processes. Organizations requested safety procedure information to be submitted by supplier/dealer.
- Team identified EHS risks of sufficient concern to justify installing engineering controls, they identified risks that require installation of engineering controls due to legal or regulatory requirements.
They identified sources of indoor pollutants from operations, maintenance or renovations conducted by personnel or contractors and implemented controls to minimize air quality.

Organizations informed suppliers of rules, procedures and controls they are expected to follow in designing new equipments.

Periodically inspect, monitor operations, equipments and facilities to ensure that they are in accordance with planned arrangements.

Companies had every kind of control in place, they had work procedures, administrative controls, Ph meters, which was technical, control, alarm system: administrative controls and physical controls like spikes. Controls were already in place and they got more into the system the controls tripled through a checklist and survey.

Organizations implemented procedures and controls to ensure that the organizations policy, objectives, and targets are met. When developing or modifying operational controls, majority of them considered those operations and activities that contributed to significant impacts.
Case 5: What procedures did you take to identify or develop Operational Controls?

The author wants to know what processes can affect organizations environmental performance based on evaluation of what is significant, and how did industries identify these necessary operational controls to increase overall environmental performance.

ISO 14001 focuses on process, it establishes guidelines that aim to optimize and standardize operational processes "through quality planning and goal setting, clear assignment of task authority and responsibility, adequate skills, and systems for documenting process performance and responding to process failures".

Interviews showed that companies mapped and documented their operational processes. This forced managers to thoroughly understand how these processes were connected, and this resulted in generating information required for the second phase. The second phase focused on improving the mapped processes by implementing proper operational controls, these improvements typically aimed at measuring process efficiency and optimization. The third phase consisted of adopting standardized best practices and procedures as part of operational controls throughout the facility.

Industries looked at their aspects and began identifying controls that were already in place and the controls that were needed; they started by writing processes and procedures. Most of the companies had operational control already in place they only codified the procedures depending on regulatory requirements. "We didn’t develop any controls, for the ISO 14001 we didn’t develop any operational procedure, they were already in place, as we got into the system the controls tripled through a checklist and survey".

Operational controls in businesses were based on a set of documented procedures and instructions. These procedures and instructions were prepared internally within the
industry. Beauty industry used the New Job Safety Assessment for every process at the facility this brought a whole bunch of questions from the entire team and everything from dyes equipment, raw material, and maintenance etc.

The experiences from already existing and functioning quality management systems at 80% of the facilities that were interviewed showed that this made the work easy. However companies said that initial approach was difficult to change which was based on the assumption that procedures and instructions should be prepared for the certifier and not the companies employees, this was due to the fact that such small companies do not require very complex documentation as was originally thought.

EMS team at the electroplating industry identified the established systems and procedures that were used to comply with ISO requirements. Interview showed that company had started tailoring their metrics to suit their business and enhance their operations at the stage of identifying aspects and impacts. They incorporated following environmental performance indicators

- Number of spills
- Permit exceedances
- Hazardous waste generation
- Pollution prevention plans

As the operational controls were installed scope of indicators were broadened in an effort to convey total environmental impact. Future indicators evaluated included the following:

Mechanical - that measure the operational efficiency and environmental impact

Navigational - that gauges if the company is heading in the right direction; appropriate sustainability metrics
**Operational Systems Indicators:**

To calculate and evaluate the environmental impact caused by the production processes, Environmental Accounting and Cleaner Production were frequently used. The Cleaner production methodology was quite similar to guidelines for Environmental accounting. This outlined procedures for conducting a preliminary assessment to identify opportunities for waste reduction or elimination. Further it described how to use the results of this pre-assessment to give priority to areas for detailed assessment, how to use the detailed assessment to develop pollution prevention options, recycling and recovery, and how to implement those options that withstand feasibility analyses.

All the sites had key performance indicators to measure performance. These were identified based on factors considered critical and were based on the company goals. To verify the controls, organizations conducted a “full system gap analysis. They had guidelines covering activities from product design and development, through production, inspection, installation etc. “We have a number of inspections that we do kind of turns problems up like we inspect our satellite accumulation, inspect RCRA storage area, inspect our facility grounds, hence we do walks through the facility and have inspection records based on those findings. We address those findings as they fall under corrective action.”

Operational system indicators were defined as the set of activities related with the design and operation of physical installations, equipment and mass and energy flow, for the deliverance of products and service. Following categories were specified to study these indicators:
• Program oriented measures
• Activity based measures
• Mass bases measure
• Standardized measures
• Concentration based measures.

**Categorization:**

Companies combined Environment Health and Safety as part of identifying operational control. “We have combined health and safety into the EMS as they overlap. When we started we ran them separately and when our company went through changes we noticed the overlap so now we have taken all the OSHA stuff and moved it into our best management practices.”

Before choosing proper operational control EHS indicators were categorized into following main categories:

• Air Emissions
• Waste water emissions
• Lost Workday Case Rate
• Occupational Safety and Health Cost Index
• Electrical Safety
• Industrial Operations Safety
• Chemical Hazard Event
• Cited Environmental Violations
• Near misses and safety concerns
• Inadequate Procedures/Procedures Not followed
• Safety system Actuations
• Safety Equipment Degradation
Case 6: How do you identify the need for operational control on new products, processes, or services?

In this chapter the researcher wants to find out what methods were used in identifying operational controls when new products and designs were brought into SMBs with Environmental Management system.

Before buying a new product, the organizations evaluated designs, methods, tools and practices to identify cost effective safety and health improvements in order to provide guidance on the use of performance based approaches. For SMBs in particular, process innovations often depended to a large extent on the competence of professional consultants or supplier of equipment.

Just as the system design underwent changes, so did the processes within the organization whenever new products or services were introduced. These changes for the SMBs were chaotic or smooth depending on the legal and regulatory requirement. As the standard calls for certain control measures to be employed to manage significant environmental aspects the same were implemented by these organizations in corresponding areas. Management committee took steps to identify operational controls associated with new processes. "At the time of new processes we mainly had two items. First we had the vendor support, so they gave us an idea of what other industries are doing in implementing the system. We looked at the holistic way on what is coming in and what is coming out, this became the best way to determine and focus on new products or designs."60,

Vendors and suppliers considered final impacts in their product development and its execution was dependent on and correlated with other environmental activities in the
Environmental Management Systems. Electroplating industry and Beauty products industry demonstrated that efforts to improve the environmental performance of the products through product development (DFE) was integrated in as part of operational control to a very high extent if it existed. Suppliers started developing environmental managements systems and eco-design programs to manage the environmental impacts associated with the production of their products as there was increasing demand and pressure from their clients to supply components and products that had improved environmental performance.

Vendors supplied with product information flow to improve environmental performance of new products, there was a considerable amount of effort by numerous manufacturers to document the environmental attributes of their products. The level of information of new products was substantially greater from purchasers, providing opportunities to improve products. “In case of acquiring a new product, for all our contractors we tell them that we are ISO 14001 certified, that we have an environmental policy, so they have to abide by it and supply products with proper controls in place as required by the standard.”

Although industries were the prime mover in implementing cleaner production, vendor support played a critical role, providing just that bit extra so that firms continue using proper operational controls. They provided support in following key areas:

- Providing information about cleaner technology (including technical assistance)
- Assisting in development of operational control tools in within the manufacturing
- Organizing training on cleaner production
Employees at the Turbine industry underwent training on the policies and got references on the environmental concerns in the orientation. The dealers send their expertise to train the workers and management on new processes and products supplied to the organization.

Achieving success in meeting environmental objectives for each new process depended upon making sure that each person responsible for maintaining or reviewing controls has received adequate training. Training programs were developed to ensure that everyone understood both the controls and their own.

When buying new instruments, equipments organizations faced the challenges of working with new technology, installing proper operational controls where necessary as part of ISO 14001 requirements. The interviews revealed that ISO teamd met and looked at operational controls for these new processes and looked at the impact its going to have on regulatory compliance and then came with solutions “When new equipment comes out we come up with a project plan.”
Case 7: Do you consider technology change as operational control and is maintenance identified as part of your operational control, and if yes then how?

The relevance of asking this question is to find out whether firms are integrating environmental considerations into their technological innovation process and whether this is considered an integral part of operational control.

Is maintenance plan used to verify equipment performance and accuracy.

According to the definition the environmental technologies and services industry comprises of:

“…..activities which produce goods and services to measure, prevent, limit, minimize of correct environmental damage to water, air and soil as well as problems related to waste, noise and ecosystems. The industry includes both end-of-pipe equipment and cleaner technologies, products and services which reduce environmental risk and minimize pollution and resource use”

As per the definition, the focus of firms was to include actual technologies and services specifically directed to solve or avoid declared or known environmental problem. Identifying these problems became particularly problematic when it came to “cleaner technologies”, which were process innovations.

Demonstration projects by firms proved that major improvements in the environmental and economic performance of companies could be made, even with substantial technology changes. Interviews showed that to make proper technology and investment decisions such assessment is crucial, as it leads to better planning and selection of new in process technologies and second to substantial reduction in end-of-pipe technologies required. “If there is change in a piece of equipment or process it could
potentially have a positive or negative impact, it can be counted as a continuous improvement if something is obsolete or an improvement on the environment".

Technology change was identified early as a key activity in the environmental management program and the companies used different types of design tools. If the facility goes for change in its technology then environmental considerations were included in the strategic process like control management, product planning. These steps were critical since fundamental parts were often settled at early stage. "Change in technology on something which is a new process has to be planned, which then goes to the process finding. This plant took into place the operational controls that are now part of the new technology so when you have some new technology you need to have some plan in place when it gets here; so any aspects of new processes have a control in place".

The team considered and improved the eco-efficiency of complete system where the controls belonged. It was important not to underestimate the time perspective for this implementation process. A long-term strategy and a step-by-step approach were taken at operational level. A plan is developed which goes to the process finding and then plan puts in place its formal regular authority of what needs to be changed.

Environmental considerations were fully integrated into normal management procedures and control systems as daily operational procedures.

"The technology control is more of objectives and targets, whereas operational control are focused on our day to day operations, objectives and targets are the ones that lead to continual improvement items."
Technology change as part of operational control was distinguished on the following:

- New knowledge and new uses for existing knowledge
- Product development
- Process development

Technological change played an important role in sustainable production defining environmental management systems and was done in four ways:

- In end-of-pipe solutions
- Enabling waste minimization or resource efficiency
- As Cleaner process technology
- In products with reduced environmental impacts.

"We will not call it a new technology but improvement of existing technology, an improvement doesn't necessarily mean you can get new colors in, it could be raw material that would have been less expensive or it could be less toxic or it could be the one that can be easily handled."  

New technology was evolved into the system and it had to go through a planning phase first, "planning phase is a detailed one so you have to look at everything; controls are your last thing, once a plan is safe its going to work on its control, if the controls are in place you are done, your inspection won't have any problem."
MAINTENANCE:

Once the operational controls are identified the companies consider the type of maintenance and calibration that might be appropriate. Maintenance of equipment that could have significant environmental impacts or result in non-compliance was considered, and the need for a plan to manage such maintenance was not overlooked. "An elaborate preventive or predictive maintenance program is not needed in all cases. Existing maintenance program was assessed and its effectiveness was measured before making significant changes."

At the electroplating industry the equipment that was referenced in the EMS was included in any item whose failure or improper operation or repair may have resulted in release of hazardous or toxic materials into the environment. Organizations had started tracking environmentally sensitive equipment in their maintenance practices before implementing the EMS.

Electroplating industry had directed specific attention to:

- Preventive maintenance programs and activities
- Predictive maintenance programs and activities
- Additional tracking in computerized maintenance management system
- Root cause analysis procedures and control.

An Environmental Engineer of an Ink manufacturing facility told us that "analysis and optimization of the preventive maintenance (PM) program for equipment items associated with the organizations significant environmental aspects was necessary to
make sure that maintenance is adequately planned. This provided the stimulus to have detailed look into the PM program and its coverage.70"

Potentially significant environmental impacts were addressed in the job plans for PM activities, “there are two starting points for this optimization: either examine existing PM activities as they come due and modify them to take into account the analysis of environmental aspects as directed by ISO 14001, or begin with a list of organizations significant environmental aspects, check for appropriate PM coverage, and set up PM actions as needed71”. Maintenance planning and scheduling functions were added to the environmental management activities and to the agenda.

Electroplating industry prepared the following questions that should be answered if need for investigation arises:

- How is backlog sorted to identify overdue preventive maintenance work?
- How do activities associated with significant environmental aspects rank in the organization’s prioritization process?
- What key performance indicators are in place for assessing whether the organization is complying with its operational controls and achieving its objectives for environmental performance?
- Are supervisors clearly responsible for seeing that environmental management activities are performed on time?

In the event of environmental excursions, root cause analysis was performed and operational control procedures, and record keeping were scrutinized for their effectiveness in finding and eliminating the source of excursions not only for the specific incident, but extending to all such similar actions and equipment items in the.
It is important for an organization that is embarking on improvement of its environmental management system to recognize opportunities for cooperation among various departments. "EHS and maintenance are the departments most impacted by the development of an EMS, each has its own resources and policies which if joined can produce a product that is viable and truly in the spirit of the organization’s environmental policy at a reasonable cost and effort."
Case 8: Who monitors the controls you have at the facility?

To identify the person who can be assigned responsibility to record information; monitor and track performance, relevant operational controls and conformance within the organization's environmental objectives and targets.

An important component of the ISO standard is field monitoring and measurement of practices. This is to ensure that procedures are followed, to discover any previously unknown problems areas, and to help rate performance.

The monitoring of process controls is to assure that all steps are adequate to meet specifications. The organizations that were interviewed established and maintained documented procedures to monitor and measure operational controls on regular basis, the key characteristics of their operations and activities that have significant impact on the environment. During monitoring, any departures from standards were picked up and counted as "non-conformance".

In answering this question, the majority of interviewees stated that operating procedures were in place when they initially started for the Environmental Management Systems, and if they required new procedures then they wrote new ones. Several personnel at Turbine Industry and Electroplating industry were assigned the responsibility to review the procedure and check for updating the plant operations, maintenance and safety like supervisor, safety engineer etc.

The organizations established a documented procedure to monitor and measure a set of frequency controls implemented that were related to significant environmental aspects. The controls were monitored on a periodic basis, if at any time the implemented
controls indicated a potential for nonconformance the "responsible manager" brought this attention to the EMS site leader and corrective action was submitted.

"ISO is very particular about consistency, communication and the identification of roles and responsibilities........", To signify the responsibilities assigned to the task of operations the organizations builds a team and mainly the team leader was given title "ISO Specialist" as that person was knowledgeable and demonstrated EMS strengths, such as team member’s awareness and commitment to environmental stewardship and protection.

Environmental Chemist of Ink Industry said, "One of the things that really seemed to impress the auditors was the expertise of team members, we had people that knew their jobs well, how their jobs relate to the environment which made task of monitoring the entire EMS and operational control easy." To coordinate the activities for the monitoring of an EMS, an environmental committee was formed at most of the facilities. This was a multi-functional committee composed of at least one representative from each of the divisions or departments of the organization. The group conducted routine checkup and gap analysis, to establish the current status of organizations against the requirements of process controls.

Companies designated the responsibility for maintaining the controls and for reviewing them to authorized person in order to ensure that procedures are followed and deviations corrected. Generally the workers responsible for significant aspect under consideration were responsible for implementing and monitoring operational controls. "If there is a regulatory change like the latest change in the piece of equipment or stack test it would come up in meetings and the authorized person was assigned to this task."
The immediate line manager was most likely responsible for regular review of the controls. It was always helpful to list those people responsible for each set of procedures. “As the operational controls are related to significant aspects, objectives and targets they are likely to change over time. As the process and business change and environmental impacts are reevaluated, different operational controls are needed. As targets are reached and new ones are established, operational controls may again be affected, hence review process should be an integral part of operational control.”

The Ink Industry that helped documenting responsibilities assigned to authorized personnel developed following worksheet:

Table 4.5: Operational Control Responsibilities

<table>
<thead>
<tr>
<th>Significant Aspect</th>
<th>Procedures (list)</th>
<th>Responsible for Maintaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste toner cartridges</td>
<td>Save package from toner cartridge Follow supplier instructions for return of used toner cartridges</td>
<td>Copier Maintenance person</td>
</tr>
</tbody>
</table>

Contact Person : Date Completed :
In few companies these accountable persons were designated for maintaining the controls and reviewing them to ensure that procedures are followed and deviations corrected. “I looked at the need for controls, entire team sat down and looked at the list of significant aspect and classified one which needed continuous monitoring, primarily I used to monitor them as we have small facility and it varies. We use monthly logs and weekly it’s been drafted by the responsible person”.

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CHAPTER V

CONCLUSION
CONCLUSION:

Environmental Management systems today promote radically cleaner production. This dissertation shows that cleaner production can be obtained throughout better housekeeping in day-to-day operational controls and radical improvements are often connected to process innovations.

Developing Operational Controls:

- As you have noticed in the analysis section for every environmental aspect your organization should determine to be significant, it is desirable that actions should be taken. These actions may include either:
  - Evaluating alternatives to make changes in processes in order to reduce the potential for impact, or
  - Writing operational control procedures for activities or steps in a production process where the potential impact may be well controlled.

- It is important to involve the people who will implement the procedures in drafting the operational controls. The interviews with the companies concluded that this can be accomplished in several ways:
  - By meeting the workers and describing them the current procedures for controls. Discussing the environmental objectives desired and by writing operational controls to ensure that the objectives will be met.
  - Have someone interview the workers to establish current procedures; then drafting the operational controls.
  - Have the workers and managers review the draft report.
Keeping the written operational controls simple and concise. They should include the appropriate actions, precautions, and notifications required. Focus on activities that may lead to significant impacts and avoid getting overwhelmed by trying to control every activity and process.

• Designate those people responsible both for maintaining the controls for reviewing them to ensure that procedures are followed, generally workers responsible for significant aspect under consideration will be responsible for implementing the operational controls. Immediate line manager would most likely be responsible for regular review of the controls.

• After Operational controls are drafted, develop a training program that ensures everyone understands both the controls and their own role in ensuring that they are followed, this includes onsite training.

• Companies need to set a target for each objective and establish measurements for environmental performance indicators. The targets should reflect correction of root cause. Measurement indicators should document changes in the causes identified, using the indicators one can determine if operational controls are helping one to meet their respective objectives.
Below mentioned is list of activities that might be improved with operational controls:

- Approval for using new chemicals
- Storage & handling of raw materials and chemicals,
- Wastewater treatment
- Building and vehicle maintenance
- Operation and maintenance of equipment
- Management of contractors
- Marketing and advertising
- Acquisition or construction of property and facilities

**Future Study:**

The future of EMS in SMBs is indelibly linked to future of EMS research. This reality provides EMS with its greatest opportunities, its greatest risks, and its greatest single need of depart from the ways of past. This study has shown us that operational control takes a total quality management approach to environmental protection. SMBs which went for EMS already had quality systems in place which made their path easy. The SMBs interviewed recognized that small business could have an environmental impact and that they could change this impact. They were aware of regulations and many recognized that their customers were at least interested in environmental issues because of quality systems in place. There is need for study that focuses on identifying and implementing operational controls for SMBs which don’t have quality systems in place.
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