

# Linking Safety to Quality for Small Manufacturing Businesses

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**Abstract** In many manufacturing settings, companies have implemented quality management system standards to ensure they meet the needs of customers. An example of a system that has been globally adopted is ISO 9001. This proactive system is abided by in an organization to maintain customer satisfaction and continuous improvement. In addition to quality, manufacturers have an obligation to care for the safety of their employees and customers. Similarly to quality, safety in the workplace should be a proactive movement. By integrating safety with quality systems, it becomes a manager's responsibility. With integration, there is an emphasis placed on conformance through management review.

**Keywords** ISO 9001, OHSAS 18001, ISO 14001, OSHA, Quality Management Systems

## 1. Introduction

For manufacturing companies working on a global scale, quality management systems are required in order to provide a superior product. A quality management system is a set of interrelated or interacting elements used to formulate quality policies and objectives and to establish the processes that are needed to ensure that procedures are followed and objectives are achieved. [1] Many international customers require a system to be in place. An example of a universally renowned quality management system is ISO 9001. ISO 9001 is the benchmark which other quality systems are measured against. There are quality management principles which maintain the success of an organization. Many of these principles can be correlated to safety. According to OSHA in 2013, there were greater than 4,000 worker fatalities in private industries in the United States. [2] The most frequently cited violations were because of improper training or design issues. Large organizations have safety management systems in place but for small businesses this may not be the case. Although

safety manuals are written and placed in company databases, there is no emphasis to regulate safety. Other than documentation, an ISO 9001 system is enforced by management and imposed by strict auditing requirements. If safety can be integrated with ISO 9001, these same strict enforcements will also be applied. For small manufacturing companies, this can be the administration of good manufacturing practices. These practices are prescribed not only to blue-collar workers but also to the white-collar workers who design the equipment.

## 2. Safety and Quality Relationship

There are eight quality management principles. These are customer focus, leadership, involvement of people, process approach, system approach, continual improvement, factual approach, and mutually beneficial supplier relationships. [3] Some of the principles directly correlate with safety in the workplace. Customer focus is the goal of satisfying the customer. A customer wants a quality product for a reasonable price. In this definition of quality, safety is a factor. Many purchasers of manufactured equipment also have their own safety standards. They expect their purchased equipment to consider good manufacturing practices.

Leadership is another principle related to safety. Leaders provide direction, establish purpose, and involve others. To perform these things, management needs to be committed to safety in the workplace. Managers establish purpose by informing their employees the importance of safety and involving them in the process. Involvement of people is also correlated to safety. By involving employees, you provide them with a sense of confidence and self-actualization. All departments are involved in the improvement of safety in the workplace. From buying quality raw materials to using the proper torqueing technique when assembling a unit, employees should be knowledgeable about their role in the safety process.

Continual improvement is very important to the role of

safety in a company. Technology changes or new customers are reasons to keep improving. While the main goal of a company may be to provide a quality product at a reasonable price, a quality product will also provide safety in the long-term. To keep improving, feedback is required as a factual approach in decision making. Decisions are made based on feedback such as surveys.

### 3. Implementation

According to OSHA, the most frequently cited violations consisted of fall protection, electrical & wiring methods, machinery guarding, and hazardous communication. [3] These violations are caused by mechanical failure, operator failure, or design error. The safety and quality portion of this paper provided several examples of a relationship between the two. Table 1 provides a list of criteria which can cause an accident.

**Table 1.** ISO 9001 Key Assessment Criteria [4]

S. No.	Key Assessment Criteria
1	Purchasing
2	Methods (procedures, instructions)
3	Tools and Equipment
4	Environment
5	Personnel (Management)
6	Facilities
7	Materials
8	Maintenance
9	Training
10	Communications

Management is the most important criteria because it has a direct influence on many of the others. In a manufacturing business, management is involved in design, training, and communication. From a design standpoint, managers approve equipment drawings and documentation. Foremen and lead men train their employees and coworkers on proper techniques when working in manufacturing setting. Communication failure is one of the key reasons for manufacturing accidents. As leaders, managers must be able to convey the purpose and direction of safety for the company. To further elaborate on communication, effective communication is developed through meetings, training, and postings such as emails.

Training of employees is another measure that can prevent safety violations. Training employees on proper use of tools and manufacturing techniques will help avoid accidents such as electrocution or falls. There is less probability for accidents from a skilled and properly trained worker.

Training can also involve the understanding of documentation like procedures. From manufacturing guidelines to engineering design procedures, all employees of a manufacturing business should be familiar with procedures found in their database. For manufacturers, this will be the appropriate steps to consider when working with electrical equipment in order to avoid possible electrocution. For engineering, human factor design must be taken into account when designing an equipment item. Machinery guarding and fall protection are two of the most cited violations. Through proper design, appropriate ladders or scaffolding may be implemented. Procedures detailing safe design criteria may be created and placed within a business's database for employee access. ISO requires documented training and verification training pertinent to job responsibilities to all employees. Within a quality manual, a section on safety may be added and these procedures should be referenced.

Equipment, facilities, and environment are other criteria items that should be considered. Good manufacturing practices should be measured when designing equipment. Engineering is required to take into account the functionality of equipment not only for operation but for safety. The project is not completed once design work is finished. The equipment will be assembled and shipped to a customer who will operate the equipment for many years. Safety procedures and training should be provided to designers in order for them to incorporate good manufacturing practices in all designs. In addition to safer equipment and skilled workers, a safe work facility and environment should be established. Proper tools such as cranes and organization such as safe storage of chemicals will prevent possible accidents from occurring. Maintaining the infrastructure associated with equipment, workspace, and utilities and managing a proper work environment not only benefits quality but has major influence in eliminating risk. [4]

Purchasing and materials are addressed in ISO 9001. Purchasing processes, verification of purchased products, and sub-supplier approval are clauses in ISO 9001. [2] It is the design group's responsibility to use appropriate materials for the specific environment the equipment will be sent to such as temperature. The purchasing department checks the background of sub-suppliers to confirm if they are a suitable vendor that can provide a quality product. The impact of quality of equipment, tools, and instruments used in production is directly correlated to safety and possible mechanical failures.

### 4. Measurement

To ensure the effectiveness of the integration of quality and safety, qualitative and quantitative measurements must be taken. Quantitative measurements are performed using statistical research. Questionnaires using Likert scales as shown in table 2 are an example of this.

**Table 2.** Likert Scale format

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

Another form of quantitative research is taking figures from the company such as number of incidents, near misses, or insurance claims. The effectiveness of safety in ISO 9001 should be shown in a decrease in these numbers.

Qualitative measurements would be sampling customers and employees. This involves providing surveys or questionnaires. Surveys of employees would be used to gauge the working environment, effectiveness of tools, and the functionality of the equipment being designed.

Internal and external audits are another way to measure the integration of safety and quality. Internal audits would involve management testing employees on their safety training. This would be testing their knowledge on safety procedures developed. External audits by a third party would be used to test employees as well as management.

### 5. Drawbacks

Many large companies have integrated ISO 14001 or OHSAS 18001 with their ISO 9001 quality management system. ISO 14001 carries safety standards with an emphasis on environmental policies and OHSAS 18001 is an internationally applied standard for occupational health and safety management. [5] Although there are previous instances of integration using OHSAS 18001 and ISO 14001, mostly large corporations are implementing these changes.

For small manufacturing businesses, there are drawbacks to making these changes. Economy and cost profit considerations and organization structure are the main drawbacks for small businesses. [6] When discussing cost/profit considerations, many companies do not believe the cost is worth the movement unless the cost of accidents outweigh the safety movement. There are higher costs when integrating safety into your quality system. These costs include training of employees, higher management salaries, and consulting costs for development. Organization structure involves the integration of safety into a whole company. Effective managers are required to be able to relay information and emphasize the importance of the new movement. Employees must be motivated in order to be aligned with company goals.

In the case study of Power Generation Business Unit, market and competitive conditions made investments in new product mandatory to succeed. This is something most small businesses are faced with because they don't know how to

fund and keep funding for quality and safety improvements. [8.] Therefore, PGBU refocused its total quality process to generate the needed cash. PGBU adopted cost of poor quality reduction as the competitive strategy and established a cause and effect framework to provide the linkage between the quality process and broader business objectives. Strategic quality planning became the means for management to articulate the need to change, set priorities and allocate resources. This sent the signal to the entire organization that the quality process was a critical part of the units long term competitive strategy for improving financial performance and price competitiveness.

PGBU turned to quality improvement and waste reduction as a means to generate necessary cash flow. In order to do so, PGBU defined three strategies to increase customer satisfaction, market share and profitability through quality improvement. PGBU used business metrics to link the units vision, strategy and performance measures that would build the framework to integrate the overall goal with day to day quality priorities and objectives of the functional unit.

PGBU believed, as well, that management had the priority in establishing a total quality culture and achieving the units goal that would require continual assessments of progress through performance measurements. In particular, the cost of poor quality measurement must clearly reflect the cost element so that it can be used in monitoring and managing quality improvement. This strategy would convey the belief that none of the cost of poor quality needed to be spent and that the cost of poor quality can be eliminated through the systematic quality improvement focused on eliminating the related root causes. Once the cost of poor quality has been identified and targeted, a QIT is formed to determine and eliminate the root causes of the problem. For example, PGBU discovered that the root cause of their problem was one third of unplanned overtime. Unplanned overtime resulted in significant costs that could be significantly reduced to redirect the funds to quality and safety measures or measurement programs.

Therefore, the PGBU study shows that it is possible for businesses, big or small, to implement safety and quality by focusing on the role of the cost of poor quality. The ability to quantify the financial impact of non -value added activities and waste provides companies with the direct connection between quality improvement and improved financial performance. Assessing the entire organization gives management a realistic estimate of the impact of poor quality on the business and highlights the key elements.

OHSAS 18001 and ISO 14001 are internally known standards but many regulations do not apply to small businesses. It does not make sense for a small manufacturing company to invest the money in a new system when many of guidelines are inapplicable.

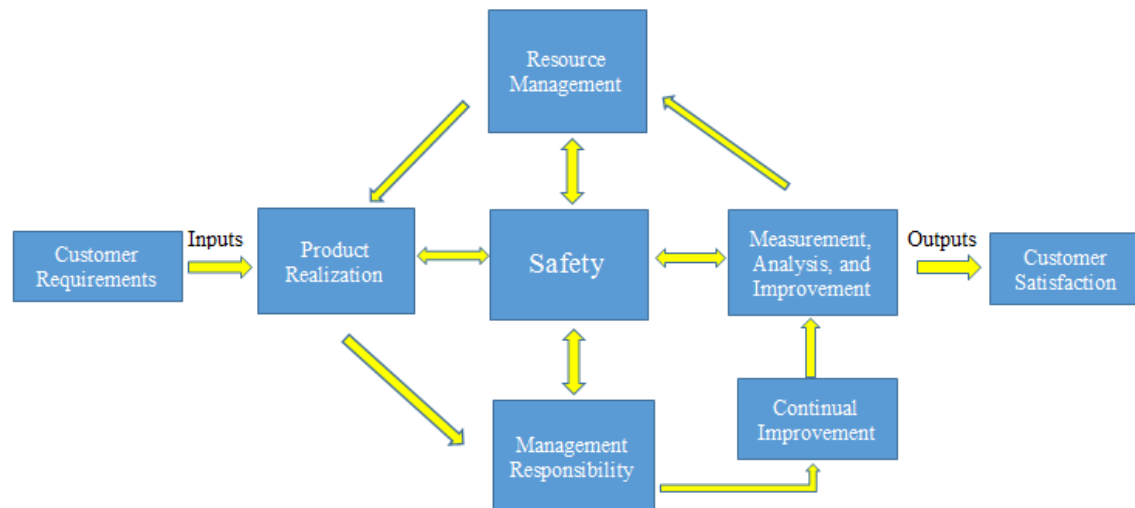


Figure 1. Proposed Quality Management System Model based on ISO 9001 [7]

## 6. Conclusions

ISO 9001 is a globally adopted quality management system that is required by many purchasers. This system implements efficient working practices that improve a business, staff, and customer satisfaction. It has been recognized that a focus on safety should be implemented within a quality management system. Although there are other safety management systems such as OHSAS 18001 and quality systems such as ISO 14001, these systems are not as simple to obtain for small manufacturing businesses. Common criticisms are the money and time required to implement. Also many of the requirements may not be applicable to a small business. For companies currently with a quality management system such as ISO 9001, safety policies may be integrated within the company's current quality system.

Safety standards directly correlate with quality management principles. Safety like quality requires leadership through management. This leadership is used to effectively involve all employees. To achieve safety through the company, all employees must be trained on safety policies similarly to quality policies. Another main focus is the customer. Quality policies are implemented to design equipment to meet customer requirements which will in turn lead to customer satisfaction. By implementing safety in policies and procedures, a company is designing and manufacturing safe equipment to meet the customers' requirements. Customer satisfaction is interrelated with good manufacturing practices. This approach will help small manufacturing businesses encourage continuous improvement and company involvement with safety.

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