Ensuring Safety in Fiberglass Reinforced Plastic Manufacturing: Best Practices for Risk Management from Human Resource Perspective

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Abstract

Risk management (RM) is a widely embraced concept in numerous companies, as it offers benefits such as enhanced productivity, increased profits, and improved business performance. The main objective of this study is to evaluate the ability of risk management to ensure occupational safety in an Egyptian company manufacturing FRP from a human resources management perspective. The conventional manufacturing processes of GRP include three main stages: (1) pre manufacturing, (2) during production and (3) after final production. A total of 14 risks have been identified and assessed using risk matrix approach. Among these risks, 5 are moderate level, 4 are low level, 4 considered as high risky level and only one considered as an extreme level of risk. Further risk evaluation is carried out by considering operational activities that can mitigate risk, both reducing the impact and the possibility of the occurrence of risks. Additionally, the current study proposes general and specified mitigation protocols that can be considered by companies in an effort to reduce the negative impact of risk.

Keywords: Risk management (RM), GRP, human resources.

1. Introduction

In recent years, the significance of human resources management has escalated, transitioning from a mere ideology to a strategic approach aimed at supporting organizations and resolving their challenges. A growing number of small and medium enterprises (Capital from 30,000,000 and 100,000,000 EGP) have come to acknowledge the importance of having a dedicated human resources team to develop a risk management plan. Given their constrained resources, it is crucial for them to promptly respond to both direct and indirect threats that could jeopardize the company's viability.

The risk is defined as the impact of a goal's uncertainty (ISO, 2009). Risk can be perceived as a potential deviation from expectations, resulting in setbacks or losses (Kasidi, 2010). These definitions conceptualize risk as the possibility of an event producing results not in accordance with expected results and causing harm to an entity. Generally, these definitions and many others in the literature frame risk as the potential for an event to generate outcomes that diverge from anticipated results, potentially causing adverse impacts on an entity.

Risk management (RM) is a widely embraced concept in numerous companies, as it offers benefits such as enhanced productivity, increased profits, and improved business performance (Ahmadi et al., 2017). Effective risk management plays a crucial role in providing reasonable assurance for the achievement of a company's objectives and helps in attaining its financial targets (Scott, 2011). It involves ongoing assessment and identification of risks, aiming to reduce surprises that can impact the organization. Integrated risk management is an integral component of sound organizational governance (Andersen, 2008). Risk management activities encompass the provision of continuous, relevant, and reliable information to executives and personnel across different levels of the organization. It also involves the design of practical frameworks and systems to ensure that risk management decisions are well-founded (Pezier, 2002). However, the objective of risk management extends beyond solely minimizing risks and risky situations. It also involves maintaining a balance between risk and return, considering that businesses are inherently associated with exposure (Watt, 2007).

1.1. Research Problem

Fiberglass is a synthetic fiber formed by melting glass in a furnace (Thomason, 2019). The molten material is then forced through small holes to form the filaments or fiber. The coarser fibers are woven to form a cloth which can be used to form fiber reinforced plastics (FRP). FRP is a versatile and widely used material in various industries, including construction, automotive, aerospace, and marine (Belarbi et al., 2016). While FRP offers many benefits, it is important to be aware of the hazards associated with its manufacturing process and implement effective risk management strategies to ensure the safety of workers and the environment.

Despite worldwide regulations and efforts in manufacturing procedures and recommendations for safe confined space work, recent statistics yet, a considerable number of fatal incidents in confined spaces (Burlet et al., 2015). Hazards in the workplace occur when the working environment can cause injury, illness or death. The hazards can result from many of the different aspects of the working space, including equipment, dangerous materials, chemicals, unsafe working practices and the behavior of people (BSI, 2001).

Developing a model to handle operational risks in the plastic products factory at the Suez Canal Authority poses a significant hurdle for the Human Resources Department. Various approaches and strategies are employed during the risk management process to assess potential losses and take preventive measures or minimize future exposure to such risks (Gordon et al., 2009).

The following main question can be asked: Can risk management, from a human resources management perspective, effectively ensure occupational safety in the glass FRP industry?

This major question leads to the following sub-major questions: -

1- What are the types of operational risks to which the plastic products factory at the Suez Canal Authority is exposed? How is it managed?

2- Which risk management design is suitable for mitigating the adverse effects of risks identified during the inventory cycle?

3- 2. What efforts can the company take to optimize the risk management design?

1.2. Research Objective

Risk management in a certain company comprises of all rules and frameworks regarding the identification, analysis, assessment, control, and response to all potential exposures (Essinger and Rosen, 1991). It also includes benchmarking the profitability and efficiency of the measures implemented to address these exposures (AS/NZS, 2004). The practice of risk management greatly differs depending on the situation and the process also has different meanings for different people.

The main objective of this study is to evaluate the ability of risk management to ensure occupational safety in an Egyptian company manufacturing FRP from a human resources management perspective.

Several sub-goals emerge from the main objective include:

1- Learn about the application of the security and safety system in the glass FRP industry, and the best practices for risk management.

2- Identify the types of risks to which the plastic products factory in the Suez Canal Authority is exposed.

3- Explaining the strategies used in risk management to ensure occupational safety in the glass FRP industry in the Suez Canal Authority sector under study.

1.3. Literature Review

1-Study (Osmani, 2019). The study aimed to identify operational risk management in oil and gas companies and work on building a model for the operational risk management system in the National Gas Company SONATRACH. The study employed a practical operational risk management model that efficiently identified and addressed risks within the shortest timeframe. The primary objective was to establish regular safeguards for the company against the specific risks it faces, thereby minimizing their potential impact. It also aimed to know the challenges facing petroleum companies in the field of risk management in general and operational risk management in particular. The study concluded that developing the company’s management behavior, despite its efforts to do so, depends on the efficiency and sincerity of human resources are the cornerstone of the success of any system of this type.

2- Study (Shenawa, Hussein, 2018). The study aimed to clarify the classification of risks into two types; internal and external, and to determine which risks require more attention. The research was based on the hypothesis that using Pareto analysis enables risks to be identified and the possibility of treating them before they occur. The study's findings indicated that there has been a lack of innovation and design in the Al Zahi 2-liter bottle, which are fundamental for creating value and ensuring customer satisfaction. Remarkably, the bottle's shape has remained unchanged since its initial production. The study recommended the need to focus on quality and use one of its tools to solve problems that occur as a result of deviations in quality and thus avoid losses.

3-Study (Sabbar Mohamed, 2017). The study aimed to diagnose the application of the industrial security system and its impact on the National Corporation for Works in Wells, by applying it to the company P.T.N.E Hassi Messaoud. The descriptive and analytical approach was relied upon. The study aimed to know the costs of the corporation in the field of security. The study recommended the necessity of implementing security and safety procedures for workers and providing individual protective equipment for each person at the work site level.

4-Study (Henriques, 2015). The study presented the concept of operational risks, methods for evaluating them, and methods for managing operational risks, especially in light of the standards of the “COSO” and “ISO” committees, in addition to the risk matrix. The study reached a set of results, perhaps the most important of which is how to manage operational risks, which is based on two stages and two types of treatment: the qualitative aspect, which represents the first stage, which includes evaluating and classifying in a descriptive manner each operational risk identified by companies, and the quantitative aspect, which represents the second stage. It aims to measure the most important operational risks through quantitative treatment, despite the presence of unquantifiable risks.

5-Study (Dubach Kouider, 2009) aimed to identify the extent to which industrial safety contributes to the prevention of work accident injuries and occupational diseases by applying it to the cable industry company B.A.C.I.N.E in Biskra. The problem of the study was the extent to which industrial safety contributes to the prevention of work accident injuries and fatty diseases? The sample represented 380 workers at the cable manufacturing establishment B.A.C.I.N.E and was selected by a simple random method. The study also aimed to shed light on the reality of industrial security in the industrial establishment, as well as an attempt to know the extent of the contribution of special training to the field of industrial security and reliance on preventive awareness methods, to prevent injuries from work accidents and mental illnesses. The study concluded with identifying the reality of industrial security in the establishment and its role in dealing with accidents. Work and fatty diseases and get to know the committee responsible for implementing the industrial security policy.

6-Study (Marcellin SIMBA NGABI, 2006). The study aimed to identify industrial risk management in compliance with security and health rules in the petroleum sector through industrial re-engineering and control of technologies and methods of internal and external organizational processes in light of globalization due to the changes it has witnessed in the exchange of knowledge in the field of technology. It also aimed to accurately identify the reliability of machines and know the expiration period of equipment by re-engineering industrial processes. Its purpose is to allow the optimal use of knowledge, the level of safety of men and equipment, and achieve time gains through analyzing and treating compromised processes. The study recommended the need to provide more One of the solutions that helps risk management in general to avoid any danger to workers.

2. Materials and Methodology

The current study uses a single case study approach which provides the researcher with a wide range of in-depth data from the qualitative exploratory method (Yin, 2003). Exploratory methods have been widely used as a research tool to obtain information from the real situation (Mohammad and Zeyada, 2023). Qualitative research focuses on development of theory, considers real practice has a non-numerical value, and is inductive when a hypothesis is not required to begin the study (Wahyuni, 2015).

2.1 Case Study

This study has been conducted on the manufacturing activity in the glass-reinforced plastics products factory which is owned by the Suez Canal Authority and located within the Port Tawfik shipyard at the southern entrance to the Suez Canal. The main activity of this factory is the construction and maintenance of marine boats made of FRP to be used in Guidance, transportation, maritime services, and rescue operations both within the Suez Canal and elsewhere.

The factory comprises of several sections, each with a specific utility, dimensions and certain number of people were involved (Table 1).

Table 1: The Factory sections in utility, area and people involved.

Name	Utility	Area	No. of People Approx.
Production Flow	the flow of materials and products throughout the manufacturing process.	35 %	53
GRP manufacturing	molds, resin mixing and dispensing systems, curing ovens, cutting and trimming machines, and finishing stations	28 %	62
Storage	storing raw materials, such as fiberglass, resin, and additives, as well as finished GRP products	20%	26
Ancillary Facilities	Administrative offices, employee facilities (e.g., break rooms, restrooms), maintenance workshops, and utility rooms (e.g., electrical, plumbing).	10 %	28
Front Office	Management, Security, and Marketing	7%	18

Source: Company's 2022 internal documents (data processed by author)

As per area, the largest section is the production flow where the flow of materials and products throughout the manufacturing process. This includes raw material storage, preparation areas, production lines, curing or drying areas, quality control stations, and packaging/shipping zones. The GRP manufacturing area is the base-ground for equipment such as molds, resin mixing and dispensing systems, curing ovens, cutting, and trimming machines, and finishing stations.

One of the most important sections in factories is the storage and warehousing facility, which is needed, particularly in the current study, for storing raw materials, such as fiberglass, resin, and additives, as well as finished GRP products for rage areas should be allocated to ensure proper organization and inventory management. Additionally, the ancillary facilities in the studied site include administrative offices, employee facilities (e.g., break rooms, restrooms), maintenance workshops, and utility rooms (e.g., electrical, plumbing). Finally, the front office exists for high management levels, information disks, security, and parking (Figure 1).

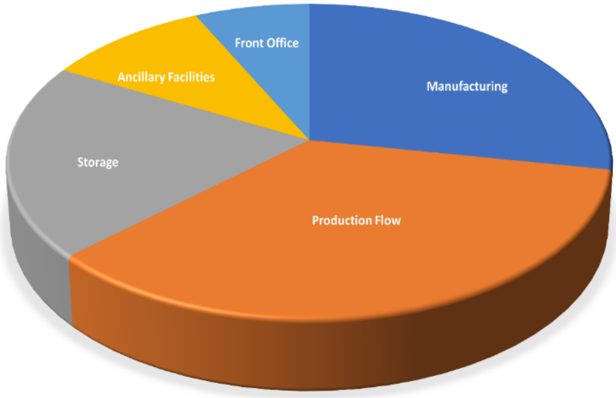

Figure 1: Aerial classification of the studied factory.

Source: processed by author.

Safety and Regulatory Requirements: Ensure compliance with safety regulations and allocate space for safety measures such as fire exits, emergency response equipment, ventilation systems, and waste management facilities.

To determine the exact area required, it is advisable to consult with industrial engineers or factory planning experts who have experience in GRP manufacturing. They can assess your specific production requirements, machinery, and processes to provide a more accurate estimation of the required area for your factory.

The FRP factory has experienced several obstacles in its operations, especially in the inventory cycle. Events with negative impact constitute risks that can inhibit value creation or reduce existing value (COSO, 2004). Despite the company's intention to implement a risk management approach to enhance overall management, a systematic approach to inventory management remains the primary focus for this manufacturing firm. Companies can choose to either directly ensure risks for protection or utilize risk management techniques to assess and evaluate risks as an alternative to insurance coverage (Moeller et al., 2009).

2.2 Data Collection Procedures

The required data for this study have been collected from interviews and observations for risk management design. Review the company’s data and perform risk maturity assessment to determine the level of corporate risk maturity before designing risk management. Interviewing and communicating with those who have expertise related to the production cycle to identify its risks.

3. Conceptual theoretical framework

3.1 Risk Management and Human Resources

Risk management is defined as a dynamic and ongoing process that involves taking appropriate measures to identify and address uncertainties that have an impact on corporate goals (Pickett, 2005). Risk management (RM) is a widely embraced concept in numerous companies, as it offers benefits such as enhanced productivity, increased profits, and improved business performance (Ahmadi et al., 2017). Risk management is a structured process employed by companies to assess, prioritize, and mitigate the potential negative impacts of uncertainties (Chapman and Ward, 1997). It is a systematic approach aimed at reducing the adverse consequences associated with specific events or circumstances. However, it is important to note that solely defining risk from a negative perspective can lead to risk aversion (Figure 2).

Figure 2: The integrated risk management processes.

Source: processed by author.

A workplace hazard refers to any potential source, situation, or substance in a work environment that has the potential to cause harm, injury, illness, or damage to the health and well-being of employees or other individuals present in the workplace. Hazards can vary depending on the nature of work and the specific industry but generally include physical, chemical, biological, ergonomic, and psychosocial factors (Choi et al., 2021). Here are a few examples of common workplace hazards (Figure 3).

- Physical hazards are physical conditions or factors in the workplace that can potentially cause harm. Examples include unguarded machinery, noise, vibrations, extreme temperatures, slips, trips, and falls.

- Mechanical hazards are those associated with power-driven machines, whether automated or manually operating. The types of mechanical injuries are typically the result of cutting, tearing, shearing, crushing, breaking, straining, or puncturing.

- Chemical hazards: These hazards arise from exposure to hazardous chemicals or substances, such as toxic gases, solvents, acids, pesticides, or flammable materials. They can lead to acute or chronic health effects, including respiratory problems, skin irritations, or poisoning.

- Biological hazards: These hazards result from exposure to biological agents like viruses, bacteria, fungi, or parasites. Workers in healthcare settings, laboratories, or animal care facilities may be at risk. Biological hazards can cause diseases, infections, or allergic reactions.

- Ergonomic hazards: Ergonomic hazards are related to the design and arrangement of workstations, equipment, tools, and tasks. Poor ergonomics can lead to musculoskeletal disorders, repetitive strain injuries, back pain, or eye strain due to improper posture, repetitive motions, or inadequate equipment design.

- Psychosocial hazards: These hazards are associated with the social and psychological aspects of work. They include factors like excessive workload, long working hours, workplace violence, bullying, stress, and lack of organizational support. These hazards can impact mental health, well-being, and job satisfaction.

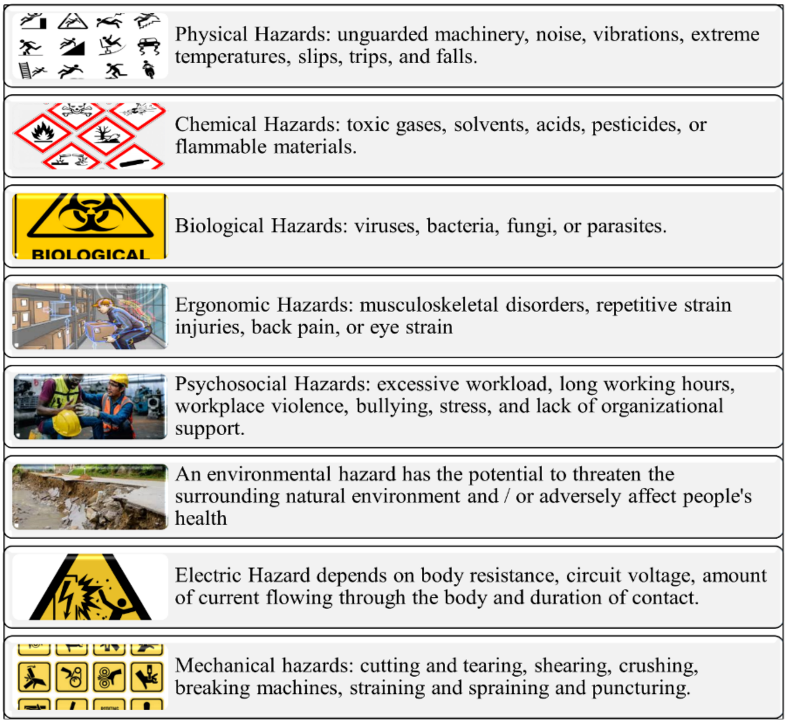

Figure 3: Potential Hazard types in the industrial sites.

Source: processed by author.

3.2 Research Hypothesis

By implementing total risk management, organizations can effectively identify events that may cause unexpected surprises and volatility, leading to reduced losses (Hoyt and Liebenberg, 2008). This approach helps stabilize earnings and improves overall company performance. As a result, the organization experiences greater stability in profits, leading to a decrease in business risk and positively impacting on its continued operation. Additionally, total risk management can have a positive impact on the cost of capital by encouraging investors to invest in the company at a lower required rate of return. This, in turn, benefits existing shareholders through increased dividends and capital gains, as the probability of bankruptcy risk is reduced. Therefore, the first hypothesis of this study can be stated as:

H1: There is a statistically significant positive relationship between risk management and company performance.

H2: There is an inverse relationship between the implementation of risk management standards and the decrease in workplace incidents in the company.

These hypotheses will be tested to determine the presence and nature of the relationship between the risk management practices and the effectiveness of HR management performance in enhancing the factory performance and mitigate the potential hazards.

4 Results and discussion

Based on the results of the analyzed documents and interviews, 14 risks have been identified in the manufacturing inventory of FRP. The researcher classified the identified risks into three stages (Figure 4).

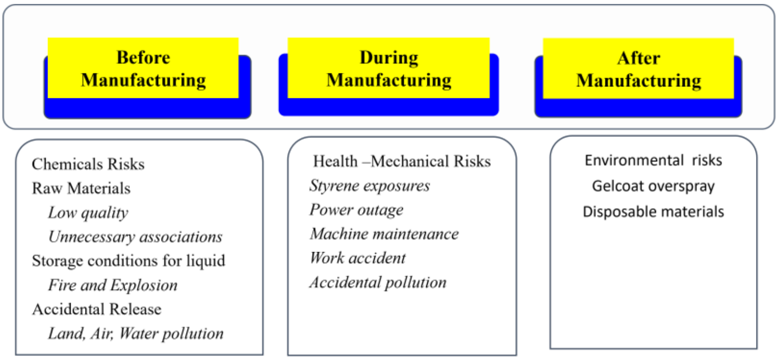

Figure 4: The identified risks in the production inventory cycle.

Source: processed by author.

4.1 Major Risks in GRP Factory

The conventional manufacturing processes of GRP include three main stages:

Stage 1: Pre manufacturing

Stage 2: During the production

Stage 3: After final production

4.1.1 Pre-Manufacturing Risks

In the pre-manufacturing stage, risks are generated mainly from the storage conditions of the chemical compounds used in the manufacturing processes such as: Gelcoat, Marine polyester, Curing agent, Accelerator and Acetone. These compounds are flammable materials, therefore the most potential risks in this stage are accidental pollution, fire, explosions and of course, property loss. Compound release is an additional potential risk that may cause health and environmental hazards as an accidental release cause land pollution, air pollution and water pollution.

4.1.2 During-Manufacturing Risks

Initially, fiber pre-forms are placed in a mold where a thin layer of anti-adhesive coat is applied for easy extraction. The resin material is poured or applied using a brush on a reinforcement material. The roller is used to force the resin into the fabrics to ensure an enhanced interaction between the successive layers of the reinforcement and the matrix materials. Spray-up technique uses a handgun that sprays resin and chopped fibers on a mold. The process is illustrated in Figure (5). It is an open mold type of technique, where chopped fibers provide good conformability, and it is more efficient than hand lay-up.

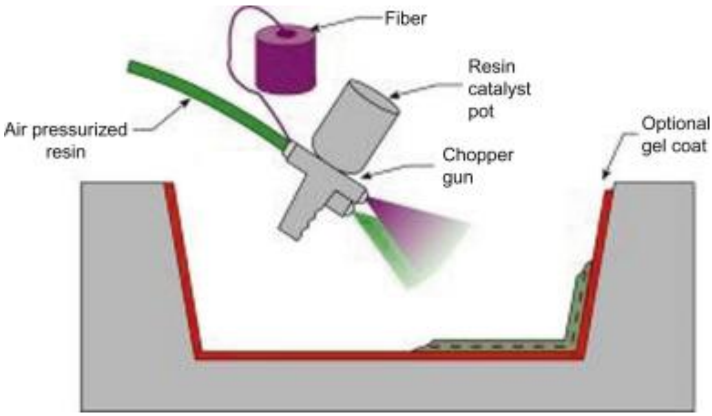

Figure 5: Dry Hand Lay-Up Process.

The main source of chemical hazards in this manufacturing stage is styrene. Styrene is a clear, colorless liquid that is derived from petroleum and natural gas by-products. During this stage, the main risk is healthy because of the process's steps and the violet styrene vapor. Humans exposed to styrene for short periods of time through inhalation may exhibit irritation of the eyes and mucous membranes, and gastrointestinal effects.

4.1.3 After-Manufacturing Risks

The disposal of industrial waste, particularly the waste generated by factories, poses a significant environmental hazard after the production process is completed. Improper handling and management of this waste can have detrimental effects on the environment. Waste sources in the factory include solvent rinse usage, empty bags, drums, and raw material containers.

4.2 Risk Assessment Matrix

A risk assessment matrix is a visual aid used to illustrate potential risks that can impact the production cycle of GRP. The risk assessment matrix illustrates the convergence of two key factors: the probability or likelihood of a certain risk carried on and its potential impact. Essentially, it provides a graphical representation of the relationship between the probability and severity of a potential risk.

The identification of Risk Impact level and likelihood in this study has been performed based on PT Company's Risk Management Guidelines as per ISO 31000 (2018) standards (Table 3-4).

Table 3: Risk Impact Criteria

Score	level	Description
5	Extreme	Potential financial loss > EGP 15.000.000 Barriers to production > 8 hours Customer complaints > 13 complaints
4	High	Potential financial loss EGP 10.000.00 < P < EGP 15.000.000 Barriers to production 7–8 hours Customer complaints 10–12 complaints
3	Moderate	Potential financial loss EGP 5.000.000 < P < EGP 10.000.000 Barriers to production 5–6 hours Customer complaints 7–9 complaints
2	Minor	Potential financial loss EGP 2.000.000 < P < EGP 5.000.000 Barriers to production 3–4 hours Customer complaints 4–6 complaints
1	Incidental	Potential financial loss < EGP 2.000.000 Barriers to production 1–2 hours Customer complaints > 3 complaints

Source: Company’s 2022 internal documents (data processed by author)

Table 4: Risk Possibility Criteria

Score	level	Description
1	Improbable	It may happen once in 3 years.
2	Remote	It happened 1 time in 1 year.
3	Occasional	It happened once in 4 months.
4	Probable	It happened 1 time in 1 month.
5	Frequent	It happened more than once in 1 month.

Source: Company’s 2022 internal documents (data processed by author)

Regardless of whether the impact and probability assessments are conducted using quantitative, qualitative, or a combination of both approaches, the resulting information must be further processed to determine the overall criticality of the risk. In the current work, the identified risks are grouped into four classes according to their determined probability and impact (Table 5).

Table 5: Risk Matrix Index

Risk Matrix		Possibility				
		Improbable	Remote	Occasional	Probable	Frequent
Impact	Extreme	Moderate (5x1)	High (5x2)	Extreme (5x3)	Extreme (5x4)	Extreme (5x5)
	High	Low (4x1)	Moderate (4x2)	High (4x3)	Extreme (4x4)	Extreme (4x5)
	Moderate	Low (3x1)	Moderate (3x2)	Moderate (3x3)	High (3x4)	Extreme (3x5)
	Minor	Low (2x1)	Low (2x2)	Moderate (2x3)	Moderate (2x4)	High (2x5)
	Incidental	Low (1x1)	Low (1x2)	Low (1x3)	Low (1x4)	Moderate (1x5)

Source: Processed by author (after Hopkin, 2012).

The comfort zone represents risks that the company feels are acceptable to take due to their perceived low likelihood or low consequences (Table 6). Both very high impact-very low probability risks and very high probability-very low impact risks fall within this category (Table 5). The extreme low likelihood or extreme low consequence risks are generally considered acceptable (Hopkin, 2012).

In the cautious zone, unacceptable risks may emerge, and their criticality increases as they progress towards the critical zone. Risks with both high probability and high impact fall into the critical zone. As shown in Table (5), risks with high impact and medium likelihood also fall into this critical zone, while the opposite combination, high probability and low impact, is considered less critical.

Table 6: Risk Level Criteria

Risk Level	Score	Management Action
Low	$X \leq 4$	Does not require any special mitigation. Risk is acceptable.
Moderate	$5 \leq X \leq 9$	Recommend mitigation where possible
High	$10 \leq X \leq 12$	Mitigation is needed to manage risk. Risk is a problem.
Extreme	$X > 12$	Immediate risk mitigation is needed. Risk is unacceptable.

Source: Processed by author.

Through interviews and observations, a comprehensive list of risks and triggering circumstances has been compiled, along with corresponding risk categories, that can be encountered during the inventory cycle of GRP (Table 7). Risks are identified without considering the company's existing control efforts (Table 8). These risks and categories have been identified based on predetermined criteria (Table 3-6).

Table 7: Risk Assessment

No.	Category	Risk	Impact	Possibility	Score	Risk Level
1	Pre-Manufacturing Risks	Counterfeit materials	4	3	12	High
2		Storage raw materials	3	3	9	Moderate
3		chemicals fire and explosions	5	2	10	High
4	During Manufacturing Risks	Styrene exposures	5	3	15	Extreme
5		Power outage	3	2	6	Moderate
6		Machine Maintenance	2	2	4	Low
7		Work Accident and stop production	4	3	12	High

8		Work Accident without stop production	1	4	4	Low
9		Accidental Pollution	4	2	8	Moderate
10		Working accidents of production operators	3	2	6	Moderate
11		Health problems of production operators	5	1	5	Moderate
12	After Manufacturing Risks	Transit accident	1	3	3	Low
13		the gelcoat and resin overspray	2	5	10	High
14		Disposable Materials	1	4	4	Low

Source: Processed by author.

Table 8: Risk Levels in the FRP factory

Risk Matrix		**Possibility**				
		Improbable	Remote	Occasional	Probable	Frequent
Impact	Catastropic	11 Moderate	3 High	Extreme 4	Extreme	Extreme
	Critical	Low	Moderate 9	7 High 1	Extreme	Extreme
	Moderate	Low	5 10 Modearte	Moderate 2	High	Extreme
	Marginal	Low	Low 6	Moderate	Moderate	High 13
	Negligibale	Low	Low	Low 12	14 Low 8	Moderate

Source: Data processed by researcher.

4.3 Risk Management Control

In this section, the author provides a range of strategies and approaches that need to be applied in order to control and mitigate the identified risks and hazards. The collected data from the factory and the interpretation of the conducted analysis show that there are two approaches: general and specified risk mitigation approaches.

4.3.1 General Approach of Risk Management

The overall objective is to systematically manage and control the inventory cycle within the factory, fostering a safe, efficient, and seamless work environment. This approach may entail implementing engineering controls, such as installing safety guards on machinery, and administrative controls, such as improving and updating standard operating procedures. It also involves providing thorough training to employees on safety protocols, hazard recognition, and correct utilization of protective equipment. Regular training sessions and awareness campaigns are conducted to reinforce safe work practices.

Implement a system for ongoing monitoring and reporting of safety incidents, near misses, and hazards. Encourage employees to report any safety concerns or potential risks they observe in the workplace. Ensure compliance with relevant safety and environmental regulations, standards, and guidelines. Stay informed about any changes or updates to regulations that may impact factory operations. Stay updated with industry best practices, regulatory requirements, and technological advancements to enhance safety measures. A further requirement to Risk Management Control's success is that executive management must assume primary responsibility for risk management in its corresponding areas (Renault et al., 2016)

4.3.2 Specified Risk Management

This approach depends mainly on the collaboration and Communication among all employees, supervisors, and management through all production stages as following:

4.3.2.1 Pre-Manufacturing Risk Control

- Original certified raw materials to be used.
- The material should be packed in an appropriate, well closed package.
- Separate storage closed air condition areas for each hazard material.
- Central air condition system covers all storage areas to maintain low temperature of the chemical material.
- Each store should be equipped with an internal temperature gauge to show the current temperature.

4.3.2.2 During-Manufacturing Risk Control

- The molding hall of the factory must be equipped with high-quality ventilation system to reduce the effect of vapors installation.
- The worker has some training in the handling of this hazard material.
- Aperiodic medical examination must be carry out for the exposed worker to health hazards.
- Personal protective equipment (P.P.E) should be made from chemical irritant resistant material.
- The worker used the special available personal protective equipment (P.P.E.) such as; hand gloves- Eyeglasses - face mask -safety shoes - overall clothes.

4.3.2.3 After-Manufacturing Risk Control

This includes (reuse – recycle – disposal by another company) to control the impact of the waste from the production.

5 Summary and conclusion

This work has identified the risks contained in the inventory cycle of Fiberglass Reinforced Plastic Manufacturing RFP in an Egyptian company. The risks were identified from observations and interviews with those who have a direct involvement in the inventory cycle. The identified Risks classified into pre-, during- and post-manufacturing risks and then evaluated by using risk matrix approach. Further risk evaluation is carried out by considering operational activities that can mitigate risk, both reducing the impact and the possibility of the occurrence of risks. Additionally, the current study proposes general and specified mitigation protocols that can be considered by companies in an effort to reduce the negative impact of risk.

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