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Article

Complementarities between Operations and Occupational Health and Safety in Garments

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Abstract: There is an ongoing debate in the extant literature regarding whether the relationship between occupational health and safety (OHS) and operational practices is contradictory or complementary. However, previous research has focused on companies situated in developed and highly industrialized countries. We contribute to the debate by investigating the relationship between OHS and operational practices in 50 selected garment factories in the context of a developing country (Bangladesh). We investigated OHS and operational practices in a developing country because the institutional context and the industrial tradition are different from those in developed countries, and these factors are very likely to influence how companies invest in enhancing work conditions and improving operational practices. Indeed, the main contribution of this study is that, in contrast to findings from developed countries, our results indicate that both the maturity levels of OHS and operational practices and the complementarity between them depended on plant size. In particular, large plants had higher levels of maturity and were more likely to perform well in both OHS and operational practices than small and medium plants. Based on these findings, we emphasize that, to enhance work conditions and remain competitive, small and medium companies must embrace multi-stakeholder initiatives involving international buyers, local government, and international labor. Organizations can contribute to building the capabilities of suppliers and balance the pressure of cost reduction with investment in OHS improvement.

Keywords: occupational health and safety; lean; Bangladesh; sustainable operations



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1. Introduction

The pressure on suppliers to improve their social performance has been mounting in developing countries, as these institutions are not only held responsible for their economic performance but also increasingly accountable for their social and environmental performance, referred to as the triple bottom line [1]. However, previous reports suggest that implementing socially sustainable practices is not straightforward and depends on the capabilities of suppliers and the availability of resources. [2–5]. Evidence from studies performed in industrialized and developed countries indicates that the relationship between operational and occupational health and safety (OHS) practices is likely to be complementary rather than contradictory; that is, improving operational practices is likely to benefit socially sustainable practices and vice versa. Moreover, research in developed countries has shown that complementarities between OHS and operational practices are not necessarily dependent on the availability of resources or plant size [6–9].

The complementarity between OHS and operational practices in developing and industrializing countries is largely unexplored, but evidence from the few available studies suggests that companies in developing countries are likely to focus on operational practices to the detriment of social practices due to the scarcity of resources and little support in the institutional context. Moreover, suppliers in developing countries are usually

responsive to pressure from international buyers [2,10,11]. For example, the authors of [10] found evidence that, under pressure from buyers to improve performance, suppliers in developing countries frequently pursue a “low road” strategy by focusing on productivity and largely neglecting the OHS of workers. However, no study has focused directly on the complementary effects between operational and OHS practices in the context of a developing country. Determining whether complementarities also exist in developing countries is critical because both the resource situation and institutional setting differ significantly from those in developed countries. Moreover, it is widely acknowledged that companies located in developing countries have access to fewer resources than companies located in developed countries.

In order to contribute to filling this research gap, our research followed the traditional approach in the “sustainable operations management” literature [12] and focused on the people component of sustainability that requires organizations to operate in a “responsible manner and to care about employee health and safety” [13]. More precisely, we studied the relationship between operational and occupational health and safety practices in a group of garment manufacturers in Bangladesh. The Bangladeshi garment industry offers a fertile context for investigating the effect of formalization on workers’ safety and health issues. Indeed, pressure from the international community and local government has been mounting on the garment industry in Bangladesh in order to improve its safety record and working conditions, as this industry has been hit by large-scale accidents with many fatalities while producing garments for well-known brands and big retailers in Europe and the USA. In consequence, garment suppliers in Bangladesh have been working intensively to upgrade their capabilities related to OHS and productivity, as international buyers require both competitive prices and compliance with codes of conduct. Moreover, while acknowledging that all developing countries are unique, Bangladesh has typical features of a developing country, such as scarce human resources and a weak institutional setting with only limited implementation of ratified labor conventions.

Our results suggest that, unlike previous research in developed countries [6,7], the complementary effects between OHS and operational practices are mostly realized in large companies, which also have more mature OHS and operational practices than smaller plants. We argue that pressure from international buyers is not sufficient on its own to improve OHS conditions for small manufacturers in Bangladesh. We then follow the extant literature and propose that multi-stakeholder initiatives involving international buyers, local government, and labor organizations are needed to support the improvement of OHS conditions in the factories of small manufacturers [14]. In the next section, we present the theoretical foundations of the paper with an emphasis on resource scarcity and institutional theory. This is followed by a section outlining the research methodology, where special emphasis is placed on the choice of research design, reflecting the challenges associated with OHS research in developing countries. The subsequent section introduces the results revealing the existence of complementarity between OHS and productivity in large companies. We then explain why large companies are able to leverage the complementarity effect. This is followed by a discussion that places these findings into perspective. Finally, the paper closes with concluding remarks.

2. Materials and Methods

2.1. Literature Review

2.1.1. Complementarity between OHS and Operational Practices

There has been a long-standing debate in the literature regarding whether OHS and operational practices are complementary or contradictory. However, a growing body of research in industrialized and developed countries indicates that manufacturing companies that focus on both OHS and operational practices are more successful than those that implement only one or neither [7,9,15]. Moreover, we find evidence that practices premised on planning, measurement, worker participation, and continuous improvement can be effective in the domains of both safety and operations [7–9]. For instance, the ISO quality

standard for the improvement of operational processes specifies the requirements for a quality management system in a company and provides a process-oriented approach to documenting and reviewing the operating procedures, structure, and responsibilities required to achieve consistent quality management. In the process of mapping work procedures, workers can potentially identify and eliminate unsafe practices [8].

Moreover, the improvement of operational practices instills new attitudes in workers that emphasize conformity, accuracy, and consistency, which can be used to identify and address OHS problems [9]. Furthermore, the development of capabilities related to quality increases the propensity of managers to adopt a range of sustainable practices. For instance, in [16], the adoption of ISO 9001 was shown to increase the propensity of managers to adopt the ISO 140001 environmental management standard, and the implementation of lean practices facilitated the prevention of environmental risks. Other studies [6,9] have observed that complementarities between OHS and operational practices are not dependent on contextual factors such as plant size or industry type. However, the findings in these streams of literature offer no or scant information on the institutional setting, and therefore, it is not clear if the findings are generalizable to developing countries.

2.1.2. Complementarity between OHS and Operational Practices in the Context of a Developing Country

Evidence in the literature suggests that, in the context of a developing country, complementarities between OHS and operational practices depend on factors such as the availability of resources and the institutional context. In particular, plant size and institutional context play more critical roles in the adoption of workplace practices in developing and industrializing contexts [2–4,10,17–23]. For instance, the results in [20] reveal that upgrades have been unbalanced in small and medium enterprises in the Bangladeshi garment industry, with limited focus on economic and technological issues. Indeed, there is evidence that, due to a lack of capabilities, manufacturers in developing countries tend to cut OHS investment as a means of cost reduction [10]; that is, to increase efficiency, manufacturers are likely to focus on operational practices to the detriment of OHS practices.

Moreover, the implementation of sustainable social practices has also been associated with the intensity of institutional pressure emanating from regulators, buyers, and civil associations towards improving working conditions and achieving a better balance between operational and OHS practices [2–4,10,17–23]. In countries like Bangladesh, the pressure towards improving working conditions primarily stems from agents based in the US and Europe. Moreover, there is evidence that large organizations receive more institutional pressure than smaller ones [2,3,24,25]. For instance, as explained in [23], it is possible that size contributes to the visibility of corporate governance practices because large firms generally attract more attention, whereas, as indicated in [24], small companies tend to experience less institutional pressure than large companies. Moreover, there is evidence that large garment manufacturers have received preferential treatment from their local government. For instance, one study [18] reported that owners of large factories received differential treatment from the state in the form of incentive and tax breaks to create a more investor-friendly climate with improved work conditions at the factory level. Given this increased institutional pressure and preferential treatment, large manufacturers in developing countries such as Bangladesh are expected to invest more in OHS improvement than small garment manufacturers.

Figure 1 presents the conceptual framework of this paper. In a developed country (upper part of Figure 1), the integrated management of OHS and operational practices is likely to increase both OHS and operational outcomes. However, in a developing country (lower part of Figure 1), the effect of integrated management of OHS and operational practices is dependent on plant size. Specifically, large plants are more likely to increase their OHS and operational performance, while small and medium plants are more likely to increase their operational performance to the detriment of OHS outcomes.

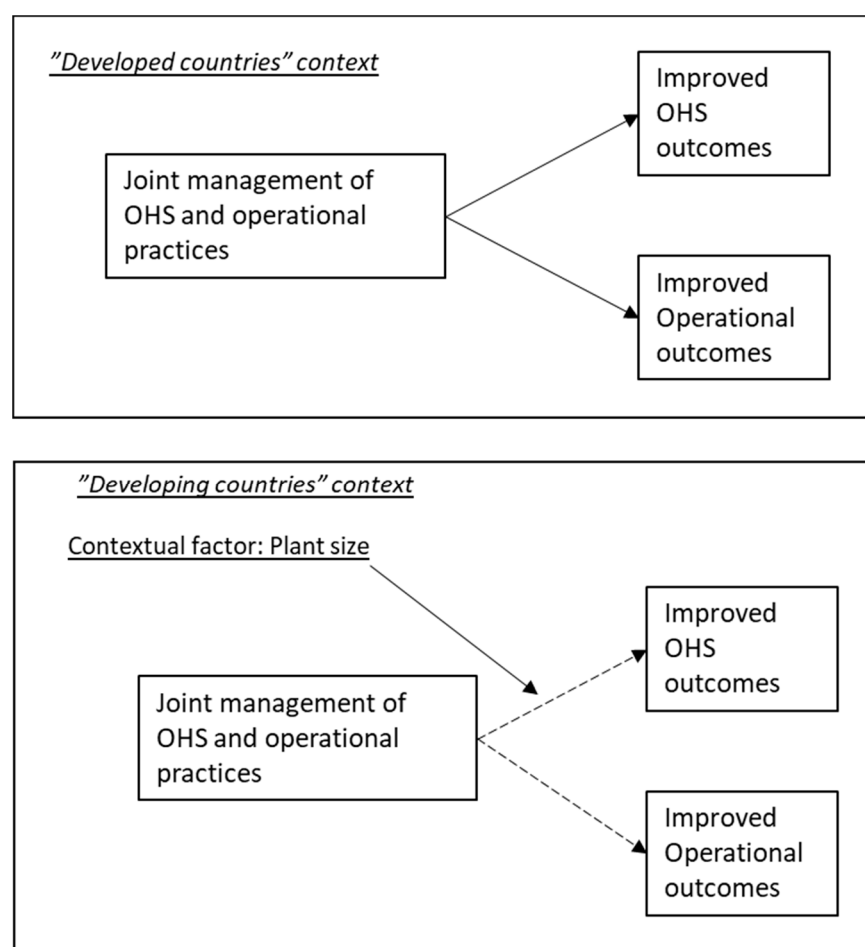


Figure 1. Conceptual model.

2.1.3. Operationalization of Constructs

Organizations use operational and OHS practices in order to manage and improve their production and work conditions [26]. To assess the maturity levels of OHS and operational practices, we developed two parallel lists of practices (Table 1). We referred to the literature on operations management and lean and continuous improvement [6,9,27–30] in order to identify operational practices for our assessment model. To identify OHS practices for our model, we reviewed the safety management literature [31–33].

Table 1. OHS and operational practices.

OHS Practices	Operational Practices
1. Leadership commitment and communication	1. Leadership support and commitment
2. Business policy	2. Employee involvement
3. Relation with buyers	3. Training
4. Objectives, targets, and performance measurement	4. Continuous improvement
5. Training	5. Value stream mapping
6. Workforce involvement	6. Control through visibility
7. OHS structure and accountability for OHS results	7. Accounting support to lean
8. Accident investigation	8. 5S/housekeeping
9. Unsafe behavior and unsafe work conditions reporting	9. Preventive maintenance
10. Legal requirements, auditing, and reviews	10. Structured flow/pull manufacturing
11. Industrial relations, welfare, and job satisfaction	11. Customer and supplier relationships

The identified practices encompassed both technical and behavioral dimensions. The assessment model consisted of five levels, ranging from the reactive application of practices

to systematic continuous improvement of practices. Therefore, we attributed a score (1–5) to each practice according to the maturity of the plant (see Appendix A.1 for a detailed description and example of each level for a selected practice).

2.2. Methodology

The main objective of this study was to investigate the relationship between operational and OHS practices in a group of garment manufacturers in Bangladesh, a developing and industrializing context not covered in previous studies. The Bangladeshi garment sector has been growing considerably in recent decades. About five thousand factories of different sizes, employing about five million (mostly female) workers, account for 83% of the country's export earnings and contribute more than 10% of GDP [34]. According to [35], Bangladesh offers two main advantages: price and capacity. However, the industry faces a number of challenges to its growth, related to infrastructure, compliance, supplier performance, workforce supply, raw materials, and political stability. The improvement of conditions and social compliance in the garment sector over the last few years can be attributed to the strong push from international buyers. However, the implementation of and adherence to stricter standards are still required.

With rare exceptions, studies (see [5]) on working environments in developing countries have involved case-based research because it is difficult if not virtually impossible to get a sufficiently large sample size with which to conduct a proper econometrical analysis. However, a drawback of case study research is that it relies solely on analytical generalizations, so it lacks statistical generalizability. Relevant registry data do not exist in Bangladesh, and companies are often reluctant to provide truthful answers to surveys. Therefore, we opted for a mid-size yet representative sample and used a combination of quantitative and qualitative data collection techniques to ensure the accuracy of the data. The mid-size sample can overcome the shortcomings of case-based research while being practical to implement in Bangladesh.

2.2.1. Selection of Companies

Ideally, companies used in research activities should be sampled randomly. However, this is not possible in Bangladesh. Instead, 50 garment manufacturers were identified through the snowball technique [36] using a set of selection criteria. The criteria were willingness to participate, size, export propensity, location, and membership in the official industrial association. We used our local contacts to identify companies interested in joining the study. All included companies were members of BGMEA (Bangladesh Garment Manufacturers and Exporters Association, Dhaka, Bangladesh) and exported 100% of their products. The manufacturers were located in Bangladesh's two main garment hubs: Dhaka and Chittagong. Moreover, since plant size is a relevant factor related to the availability of resources and the intensity of institutional pressure, we chose plants of different sizes. Plant size was defined according to the number of employees and re-coded into ordinal ranks: small (rank 1), medium (rank 2), and large plants (rank 3) (see Table 2).

Table 2. Sample distribution by plant size.

Number of Plants According to Size			Total
Small (Rank 1) <500 Employees	Medium (Rank 2) 500–2000 Employees	Large (Rank 3) >2000 Employees	
8	19	23	50

2.2.2. Data Collection

Data were collected by three teams of researchers from the Ahsanullah University of Science and Technology (AUST) in Bangladesh in collaboration with three researchers from Aalborg University (AAU). Each team consisted of a senior (professor/associate professor) researcher, a PhD student, and a research assistant from AUST. A Danish researcher was

responsible for coordination and quality control throughout the process. The Danish researcher participated in selected data collection activities with each team and checked the quality of all reports for each company (a case report containing data was prepared for all companies).

Data on the 50 garment manufacturers were collected over the period of a year (from June 2015 to June 2016). The data collection involved 2–3 full-day visits to each supplier, including an introductory visit. The purpose of the introductory visit was to secure the necessary social ties and consent from company managers, plan the subsequent data collection visit, collect basic information about the company, and get an overview of the production set-up.

The main data collection step for the assessment of practices took place as soon as possible after the introductory visit and lasted for one full day. The purpose was to collect the necessary information from the company and to evaluate the dimensions of practices related to OHS and operations. To triangulate different data sources, the researchers collected evidence covering numerical measurements and indicators of productivity and OHS, minutes of meetings (safety committee meetings and others), copies of the company's policies and norms, descriptions of projects and programs, training material, and operating procedures. Moreover, semi-structured interviews were held with managers representing different organizational functions. The teams held at least 10 semi-structured interviews per company (see Appendix A.2). Informants were purposefully selected on the basis of their job functions. We included the general manager, production manager, quality manager, and HR/OHS manager. In some companies, the department heads were accompanied by deputy heads to ensure data accuracy. In addition, the researchers interviewed welfare officers when necessary and line managers, supervisors, and workers when inspecting production facilities (see Appendix A.2). The number of interviews varied slightly between factories because they had slightly different organizational structures (e.g., HR and OHS were merged into one function in some companies and were separate functions in others).

Two members of the research team (PhD student and research assistant) conducted the interviews, all of which were transcribed. HR/OHS managers and their teams constituted the main source of data for assessing the maturity level of OHS practices. For the assessment of the maturity level of operational practices, production managers and supervisors were the main source of data. Thus, the data used to assess the maturity levels of OHS and operations were obtained from different informants, thereby avoiding a source of bias (i.e., common method bias).

2.2.3. Validity and Generalizability of the Results

In the literature, attempts to investigate workplace practices have mainly been based on self-reported and perceptual reports [37]. We used data based on assessments by researchers, which increased the validity of the measures and thus our results by avoiding methodological problems that arise when relying only on self-reported data [37].

The three data collection teams initially received two days of training related to the assessment methodology. Subsequently, two companies (not included in the sample) were used for pilot testing and training. In the pilot phase, the interview guides were tested, the method was adjusted, and the assessment criteria were fine-tuned. In addition to the pilot test, we selected experts (consultants, managers, and researchers) from Bangladesh and Denmark on the basis of competencies, who reviewed the practices and scales (see Appendix .1 for an overview of the expert information). Five levels of development were created and operationalized to measure each item. The experts validated practices and scales, providing the foundation for the data collection.

For example, based on the pilot study results and expert recommendations, we introduced two OHS practices (Business policy and OHS structure and accountability for OHS results). Business policy covers an important element related to how a company approves and prioritizes investments to improve OHS conditions. OHS structure and accountability for OHS results also emerged as an important factor, as it reflects how companies allocate

responsibility and accountability for OHS in the organization. The criteria used to define each stage or scale of maturity were improved by adopting similar measures for all OHS and operational practices, as detailed in the following:

1. Reactive (rank 1: lowest) was defined as the stage at which a company lacks structure, and actions are taken to react to pressing issues (firefighting).
2. Formal (rank 2) was described as the stage at which a company starts creating structure to improve the corresponding practices. Consultants are usually used in this phase.
3. Deployed (rank 3) was defined as the stage at which a company has established measures to follow up on improvements, and employees are being trained extensively.
4. Autonomous (rank 4) was classified as the stage at which continuous improvement is supported by top management.
5. Way of life (rank 5: highest) was defined as the stage at which continuous improvement is embedded across all levels of the organization.

The above generic criteria for ranks 1–5 were applied to all 22 practices, which increased the validity and comparability of the assessments.

Afterwards, all participating researchers carried out a full assessment of the maturity level of OHS and operational practices, and the coefficient of inter-rater reliability (ICC) of the different team members involved in the assessment was calculated. The ICC in the pilot phase was 0.818. The measurement of this coefficient was repeated, and it reached 0.92 during the main data collection period. For each company, the PhD student and the research assistant carried out the initial assessment, and this was subsequently checked by the senior researcher. Afterwards, quality control was carried out by AAU researchers, who checked the consistency and completeness of the data for each of the 50 companies. These comprehensive quality control processes ensured a high degree of data validity. The interviews were conducted in English when the Danish research team was present. At other times, the interviews were conducted in Bengali. The quality of translations to English was checked in two ways. The Bangladeshi researchers co-translated the interviews and constantly aimed to create a shared understanding of the contextual meaning in the interviews. The quality of the translations was subsequently verified by a Danish researcher, who double-checked for linguistic ambiguity and errors.

2.2.4. Calculation of the Average Score (Maturity Level)

The collected data were used to estimate the maturity levels. The teams collected data on 11 practices for OHS management and 11 practices related to operational improvement. The data assessment entailed assigning an ordinal rank from 1 to 5 to each practice (reactive: rank 1; formal: rank 2; deployed: rank 3; autonomous: rank 4; way of life: rank 5). The aggregate score of each plant was calculated by averaging the individual ordinal scores of the 11 practices (see Table 3 for an illustrative example). Thus, each of the 50 companies received two scores (maturity levels): one maturity level is related to OHS practices, and the other is attributed to operational practices. This conversion method (calculating the average of ordinal numbers) has been previously used in studies on operations [38]. Moreover, we had a relatively high number of practices (11 practices), rendering this conversion less problematic.

The average scores were subsequently used in the statistical tests. Relying on a mid-size sample size came with certain challenges. The sample size, for example, made it difficult to implement large sets of control variables. For this reason, we relied on linear regression between two variables (maturity levels of OHS and operations). Linear regressions with multiple variables, such as client base, level of investment, technology adoption, certifications, awards, and ownership, could have been possible with larger data sets. However, the selection of the sample ensured that we did not have to rely on control variables; collecting additional reliable control variables would have made it almost impossible to conduct the study in practice in Bangladesh. Securing access to valid data is a highly resource- and time-consuming process.

Table 3. Illustrative example for the calculation of the aggregate score. (Maturity level of the plant).

Practices for Operations	Score
Leadership support and commitment	3
Employee involvement	3
Training	2
Continuous improvement	2
Value stream mapping	3
Control through visibility	2
Accounting support to lean	1
5S/housekeeping	3
Preventive maintenance	3
Structured flow/Pull manufacturing	3
Customer and supplier relationships	2
Average score (maturity level)	2.45

2.2.5. Controlling for External Factors

While the focus on one industry might have limited the statistical generalizability of the results, it could have increased the validity of our findings for the garment industry. Indeed, the criteria used to select the manufacturers in this study controlled for a range of contextual factors, which enhanced the validity and the comparability of the results across companies. In our sampling, the companies were homogenized on the basis of the following criteria:

Industry type/product type. All 50 companies were export-oriented and were members of BGMEA (Bangladesh Garment Manufacturers and Exporters Association). The main activity of all the companies was sewing basic ready-made garments.

Ownership structure. All 50 companies were family-owned and shared a similar management culture. In a typical family-owned company in Bangladesh, one or more family members are responsible for the daily management of the company and make most of the important business decisions.

Unionization. The unionization of workers in the garment sector in Bangladesh is very low, as trade unions suffer from an acute lack of credibility among factory owners and the public in general [38]. Therefore, the effect of “unionization” on the empirical results can be safely ignored.

This methodological compromise was a precondition for moving beyond case studies and self-reported (and thus untrustworthy) data in the context of developing countries.

3. Results

To investigate the degree of complementarity between the maturity levels of OHS and operational practices, we calculated the Pearson correlation coefficient between the two scores for the whole sample. Tables 4 and 5 present the descriptive statistics and the Pearson correlation of the maturity levels of OHS and operational practices. The correlation coefficient was equal to 0.794 and was significant at the 1% level. The three assumptions underlying Pearson correlation—namely, the normal distribution of data, homoscedasticity, and the existence of a linear relationship between the two variables (through visual inspection)—were verified. The normal distribution of the data was first evaluated by calculating skewness and kurtosis values, which were acceptable. Moreover, we were unable to reject the assumption of normality at the 5% significance level (Shapiro–Wilk test). Finally, we checked for the homoscedasticity (same variance) of the data by plotting the standardized residual to the dependent variable (OHS maturity level); homoscedasticity did not present a challenge.

Table 4. Descriptive statistics of the maturity levels of occupational health and safety (OHS) and operational practices.

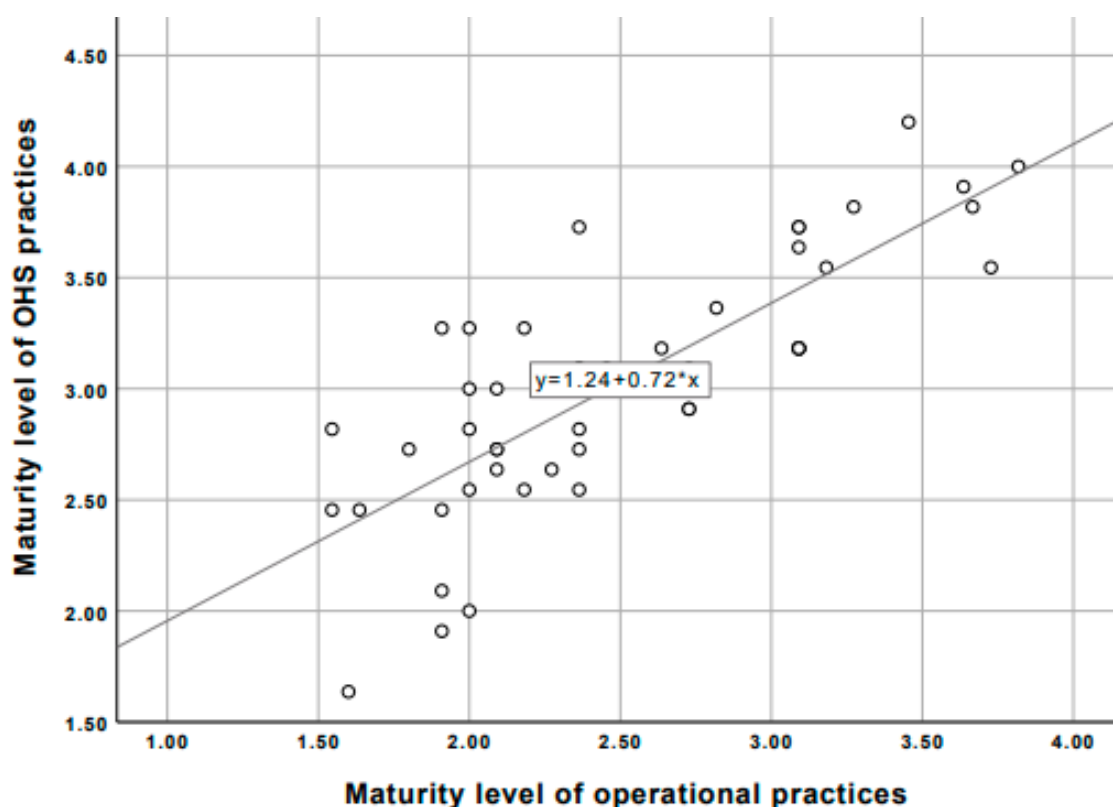
	Mean	Std. Deviation	n
Maturity level of OHS practices	3.02	0.5493	50
Maturity level of operational practices	2.49	0.6099	50

Table 5. Pearson correlations of maturity levels of OHS and operational practices.

		Maturity Level of OHS Practices	Maturity Level of Operational Practices
Maturity level of OHS practices	Pearson Correlation	1	0.794 **
	Sig. (2-tailed)		0.000
	n	50	50

** Correlation is significant at the 0.01 level (2-tailed).

As illustrated in Figure 2, the existence of a linear relationship between the two variables was checked by adding a linear regression line to the scatterplot of the maturity levels of OHS and operational practices ($Y = 1.24 + 0.72 \times X$, where X and Y represent the maturity levels of operational and OHS practices, respectively). The linear correlation between the two variables was confirmed through visual inspection.

**Figure 2.** Scatterplot with regression line of maturity levels of OHS and operational practices.

For the normal distribution of data, Table A4 in Appendix A.3 shows that the skewness and kurtosis values were acceptable. Moreover, the assumption of normality could not be rejected at the 5% significance level (Shapiro–Wilk test).

Finally, we checked for the homoscedasticity (same variance) of the data by plotting the standardized residuals to the dependent variable (OHS maturity level). A visual inspection of Figure A1 in Appendix A.3 shows that the plots are more scattered to the right of the

figure, which indicates an increase in variance. However, we did not consider this increase to be excessive, and we were still able to accept the homoscedasticity assumption.

3.1. The Effect of Plant Size

Next, we investigated the effect of plant size on the presence of a correlation between OHS and operational practices by dividing the sample into three groups: small, medium, and large plants. We calculated the Pearson correlation coefficient for each of the three groups (large, medium, and small plants) and checked for a linear fit between the two variables. Table 6 shows the correlation coefficient and the significance level for each group. The results show a significant correlation for large companies, a borderline significance for medium companies, and a non-significant correlation for small companies.

Table 6. Pearson correlation coefficients of maturity levels for large, medium, and small plants.

	Pearson Coefficient	Significance (2-Tailed)	Sample Size
Large plants	0.844	0.000	23
Medium plants	0.571	0.013	18
Small plants	0.485	0.186	9

Figure 3 shows scatterplots with linear regression lines for the three types of plants. Data from large companies present a better fit around the regression line than medium and small plants. These results suggest that plant size affected the strength of the correlation between the maturity levels of OHS and operational practices. Specifically, large companies were more likely to have had an OHS system with a high (low) maturity level if their operational practices had a high (low) maturity level and vice versa.

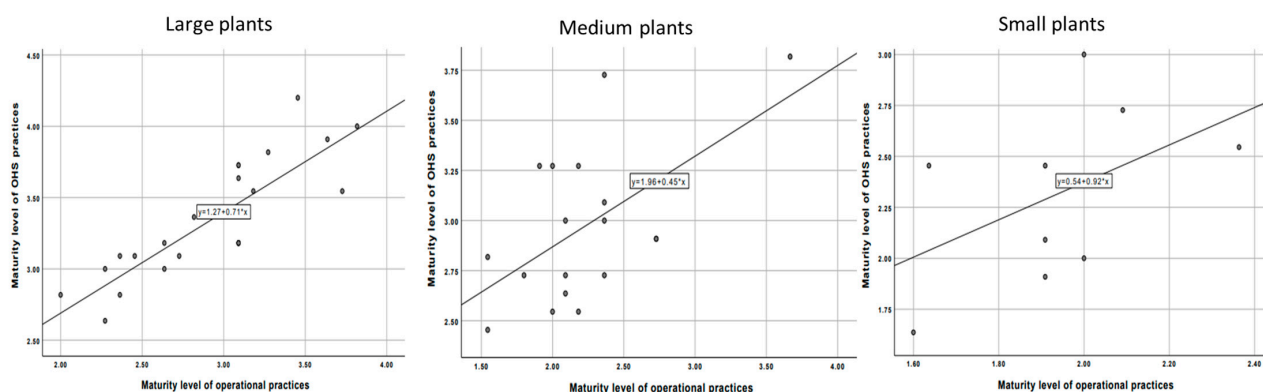


Figure 3. Scatterplots for the three groups (large, medium, and small) with linear regression lines.

3.2. The Analysis of OHS Practices

Table 7 presents the descriptive statistics related to OHS practices. We can observe that the maturity level increased with plant size, and the variance varied slightly. In this test, the number of cases varied between plant sizes.

Table A5 in Appendix A.3 reports the results of the main significance test (F test), which rejected the equality of means among the three plant sizes ($F = 20.942$ at the 1% significance level). Table A5 also contains the partial eta-squared (PES) value for plant size ($PES = 0.471$), which means that 47.1% of the variance in the OHS maturity level was explained by plant size. This result represents a moderate to strong effect (a PES value above 1 is considered a very strong effect). The observed power (power of the analysis) was 1.0, which is the maximum value (results with an observed power above 0.8 are considered accurate and valid).

Table 7. Descriptive statistics of the general linear model (OHS practices).

Dependent Variable: Maturity Level of OHS Practices.			
Plant Size	Mean	Std. Deviation	<i>n</i>
1	2.3131	0.43387	9
2	2.9697	0.238569	18
3	3.3447	0.41463	23
Total	3.0240	0.54927	50

In Appendix A.3, we also report the results of post hoc tests, which are shown in Table A6. The results show that subset 1 contained plant size 1 (small plants), and subset 2 contained plant sizes 2 and 3 (medium and large plants). These results show that the maturity levels of OHS for small plants were significantly different from those of medium and large plants. However, the OHS maturity levels of medium and large plants were not significantly different from each other.

3.3. The Analysis of Operational Practices

Table 8 presents the descriptive statistics related to the maturity level of operational practices. These results show that the mean maturity level increased with plant size.

Table 8. Descriptive statistics of the general linear model (maturity level of operational practices).

Plant Size	Mean	Std. Deviation	<i>n</i>
1	1.9354	0.22910	9
2	2.2229	0.48644	18
3	2.9249	0.49464	23
Total	2.4941	0.60991	50

Table A7 in Appendix A.3 reports the results of the main significance test (*F* test), which rejected the equality of means among the three plant sizes ($F = 20.097$ at the 1% significance level). Table A7 also contains the partial eta-squared (PES) value of plant size (PES = 0.461), which means that 46.1% of the variance in the maturity level was explained by plant size. This result represents a moderate to strong effect (PES > 1 is considered a very strong effect). The observed power (power of the analysis) was 1.0, which is the maximum value (results with an observed power above 0.8 are considered accurate and valid).

Table A8 in Appendix A.3 shows the result of post hoc tests. Subset 1 contained plant sizes 1 (small plants) and 2 (medium plants), while subset 2 contained plant size 3 (large plants). These results show that the maturity levels of operational practices of large plants were significantly different from those of small and medium plants. However, the maturity levels of small and medium plants were not significantly different from each other.

4. Summary of Findings

The results of correlation analysis suggest that large plants had higher maturity levels of both OHS and operational practices and higher correlations between OHS and operational practices. To ensure the validity of the results, we checked the three assumptions underlying the correlation analysis: the normal distribution of data, homoscedasticity, and the existence of a linear relationship between variables. All three assumptions were verified, which supports the validity of the findings. The next section contains an in-depth discussion of the statistical findings.

5. Discussion

To the best of our knowledge, this is the first time that the complementarity between operational and OHS practices has been investigated in a developing and industrializing country, as previous studies have focused on industrialized countries [6,9,15]. Our results have similarities to and differences from studies on this subject in developed countries. The findings are similar to those in developed countries in that large plants had more mature OHS and operational practices and tended to more intensively implement new workplace practices than smaller plants [8,39]. However, our results differ from those based on developed countries in that the complementary effects between OHS and operational practices in developing countries seemed to be strongly dependent on plant size. Similar studies in developed countries have mentioned that complementary effects between safety and operational practices do not necessarily depend on plant size [6,9].

It is, however, interesting that the association between operational and OHS practices also seemed to hold for large plants in an industrializing country such as Bangladesh, where institutional dynamics in the home countries of international buyers have affected local practices. This may be the case for Bangladesh in particular because the data in this study were collected two or three years after the Rana Plaza accident. It is likely that the institutional context in Bangladesh affected the results by motivating especially large suppliers with more market visibility to international buyers to increase their investment in OHS practices [2]. Indeed, after the accident, garment manufacturers in Bangladesh were subjected to strong institutional and legal pressures to improve safety, which came as a response to pressure from international buyers. In addition to strengthened local labor legislation and law enforcement, international buyers have established legally binding agreements with brands, local companies, and trade unions to work towards a safe and healthy ready-made garment industry in Bangladesh (e.g., the “Accord” (<http://bangladeshaccord.org/>) (accessed on 25 February 2021)) and the “Alliance” (<http://www.bangladeshworkersafety.org/>) (accessed on 25 February 2021)). It is therefore likely that the link between operational and OHS practices was weaker at an earlier stage of the industrial development of Bangladesh. Because our project was initiated after the Rana Plaza accident, we could not measure the previous weaker association, but semi-structured interviews carried out prior to launching the project qualitatively validated this assumption. Furthermore, the weak association as well as the general low level of maturity in small plants indicates that the complementarity between operational and OHS practices cannot be taken for granted; in other words, if a company improves one set of practices, the other set of practices does not necessarily improve automatically. Instead, the results highlight the fact that small companies need support from stakeholders and international players in the global value chain in order to acquire the resources and abilities to make long-term commitments to the improvement of both sets of practices [38].

As a practical implication, this study strengthens the emerging evidence that it is possible to jointly manage OHS and operations and increase the complementary effects between the two domains. However, the pressure to enhance social performance combined with a lack of resources can easily encourage decoupled processes that have little impact on improving OHS conditions in their organizations [2,15]. In other words, if garment manufacturers lack the capabilities and resources to implement and sustain improvements in OHS and operations, it is likely that the effects of these improvements will not reach shop-floor workers. In particular, Hasan and Lund-Thomsen [14] argued that, in order to enhance work conditions, it is essential to map the governance processes through which multi-stakeholder initiatives (MSIs) in global value chains are implemented and controlled, as well as to map the impact that MSI standards have on work conditions. For instance, the authors of [19] specify that a functional corporate governance model is urgently needed for family-based enterprises and groups. Then, efforts should be made to gradually phase out the direct involvement of the board in daily management and operational matters. Moreover, to build the capabilities of small and medium manufacturers, powerful garment associations (The Bangladesh Garment Manufacturers and Exporters Association

(BGMEA) and Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA)) are expected to lead initiatives for industry–university collaborations for the development of managerial capabilities among garment manufacturers [20].

Given the influence of buyers' pressure on suppliers, there is an urgent need to remedy the excessive effects of power asymmetry, which is usually expressed in terms of a price squeeze and a sourcing squeeze [18]. Price and sourcing squeezes are likely to primarily affect small and medium suppliers. In this context, private and state mechanisms could complement each other by supporting improvement initiatives. For instance, the authors of [20] suggested that low-interest credit to fund technology upgrades might be needed in order to enable garment manufacturers to modernize their production processes without cutting work-related expenses. Moreover, aligning inspection guidelines with international standards, setting up standard operating procedures for auditing and inspection, and ensuring transparency in the inspection process are likely to promote a better balance between operational and OHS practices in garment manufacturers [18–20].

Limitations and Further Research

The findings of this study have limitations that must be considered in the assessment of the results. The study was performed using a sample (50 plants) limited to one industrializing country. Moreover, because of the absence of systematic databases of garment companies, it was not possible to select the plants randomly.

Furthermore, all the companies in this study were export-oriented and were members of BGMEA. Therefore, all companies in this sample had to comply with a set of criteria regarding working conditions to qualify for BGMEA membership and to export their products. The relationship between OHS and operational practices is expected to differ in plants dedicated to the local market with no direct involvement from international buyers; this needs to be further investigated.

In addition, we believe that the role of plant size is worth investigating further, as there is an indication in the literature that direct measures (other than plant size) are needed to account for the different theoretical perspectives [40]. Plant size is not a direct or unique measure of either the availability of resources or institutional pressure individually. Consequently, plant size does not have a clear one-to-one correspondence with a single theoretical argument, as it reflects both the availability of resources (contingency perspective) and increased institutional pressure to improve OHS conditions (institutional perspective) [41].

6. Conclusions

Our results support the emerging theory that operations and OHS priorities are neither inherently complementary nor inherently contradictory, and this also seems to be the case in the context of an industrializing country such as Bangladesh. The main novelty of our study is related to the stronger influence of plant size on the presence of complementary effects between OHS and operational practices compared with similar studies in developed countries. Indeed, plant size, as a proxy variable for the availability of resources and institutional pressure, seems to play a more important role in explaining the relationship between OHS and operational practices in developing countries. Therefore, to advance the sustainability agenda, local and global stakeholders ought to support small and medium suppliers in developing countries to build their capabilities. More specifically, international buyers ought to avoid sending mixed and confusing signals to suppliers by striking a better balance between pressure to improve work conditions and pressure to reduce costs.

In conclusion, this study strengthens the emerging evidence that it is possible to jointly manage OHS and operations and increase the complementary effects between the two domains. However, if garment manufacturers lack the capabilities and resources to implement and sustain improvements in OHS and operations, it is likely that the effects of these improvements will not reach shop-floor workers. Therefore, mapping, implementing, and controlling the governance processes, such as safety management systems, transparent codes of conduct, and joint auditing through multi-stakeholder initiatives and standards in

global value chains, are crucial for enhancing work conditions. Moreover, a remedy for the excessive effects of power asymmetry expressed in terms of a price squeeze and a sourcing squeeze is needed to build the capabilities of suppliers and improve their work conditions.

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Appendix A.

Appendix A.1. Interview Protocol

We developed a methodology for the assessment of each practice on a scale from 1 to 5. This section presents an example of the assessment of one of the practices related to OHS (Leadership Commitment and Communication), excerpts from interviews, and the evidence used to classify companies into each of the five ranks (we have similar data for the assessment of the remaining 21 practices).

Table A1. Leadership Commitment and Communication (OHS practice).

Reactive	Formal	Deployed	Autonomous	Way of Life
Leadership Commitment and Communication (OHS practice)				
<ul style="list-style-type: none"> - The responsibility for accidents falls on workers, who are blamed for accidents. - Communication occurs only after accidents. - Management focuses only on production goals. - No investigation of causes of accidents. 	<ul style="list-style-type: none"> - The responsibility for accidents falls on the safety department and workers. - Communication about safety includes information about safety prevention. - Management introduces and follows up on a few safety goals, but focus is still on production goals. - There is a formal process for the investigation of accidents, but it is not followed. 	<ul style="list-style-type: none"> - There is increased awareness of the allocation of responsibility to different functions in the organization (mainly production and safety functions). - Top-down and one-way communication occurs before and after accidents. - Top management focuses on a range of KPIs related to safety and follows up on them. - There is formal process for accidents, which is followed, but the output is not consolidated or used for safety improvement. 	<ul style="list-style-type: none"> - The responsibility for safety is shared between production and safety departments. - Awareness and initiatives are in place to establish two-way and continuous communication on safety (top-down and bottom-up). - Top management follows up on safety goals and commits resources to the improvement of safety goals. - There is a formal process for accidents that is consistently followed. - Root causes of accidents are identified. 	<ul style="list-style-type: none"> - Management looks at the whole system (process, people, and culture). - A continuous and two-way communication process for safety is established. - There is a follow-up system for the improvement of safety goals, and commitment is in place across different organizational levels. - There is a formal process for investigation, which is followed at the various levels of the organization (management, supervisors, and workers).

Table A2. Inclusion criteria and illustrative excerpts from the interviews and evidence.**Reactive (Rank 1):**

Criteria for inclusion: Interviews and observations reveal that workers are blamed for accidents; root cause analysis for accidents is absent; one-way top-down communication indicates that worker behavior is the cause of accidents; the management priority is to limit the damage and resume production. Management is not interested in taking actions apart from telling workers not to cause problems.

Excerpts from interviews and evidence:

Interviewed managers often declared that “workers don’t follow the rules” and “we told them to follow the rules many times” without checking whether workers know or understand the rules.

The communication from managers to workers focuses exclusively on the behavior of workers as the cause of accidents. According to one manager, “we tell the worker if you don’t change your behavior the accidents will continue”. In this case, communication ignores other possible causes of accidents and how the process could be changed to avoid accidents.

According to one manager, “accidents are bad thing and we aim to reduce the impact of accidents on production”. The manager did not elaborate on the effect of accidents on workers. In this case, there is no established process for accident investigations. Managers usually ask what happened, and the causes of accidents are guessed based on personal beliefs. For instance, one manager stated that “workers don’t follow the procedure and they are responsible for accidents”.

Formal (Rank 2):

Criteria for inclusion: Interviews and observations reveal that management recognizes that safety is a shared responsibility, but the facts do not reflect this attitude; communication is still top-down but focuses on the prevention of accidents; the process of root cause analysis exists but is not followed.

Excerpts from interviews and evidence:

In the companies, managers believe that safety is a shared responsibility, but they still blame workers or the safety department for accidents.

According to one manager, the “safety department should take strict control to avoid accidents because you workers don’t always follow the rules”. Communication after accidents mentions preventive actions, and the company uses posters and flyers about safety on the shop floor as a tool for accident prevention.

Managers have introduced safety goals to production and follow up on measures such as the number and types of accidents. There is a process for investigation, but either it is not followed, or relevant steps are omitted. For instance, the researchers observed that the assessment and analysis of different potential causes of accidents were not complete or conclusive.

Deployed (Rank 3):

Criteria for inclusion: Interviews and observations reveal that management recognizes that safety is a shared responsibility (and workers are not blamed for accidents), but responsibilities for accidents are still not clear; continuous and direct communication occurs between management and workers about accident prevention; KPIs related to safety goals are in place; causes of accidents are investigated, but the process is not effective enough to avoid repeating the same errors.

Excerpts from interviews and evidence:

Managers in the companies believe that responsibility should be shared, but the criteria are not well established. According to one manager, “when accident happens, production and safety departments meet but they don’t always agree about the responsibility for the accident nor about the improvement actions to avoid future accidents”.

In addition to the formal stage, managers use direct and continuous communication with workers before and after accidents. According to one manager, “we tell our workers that prevention of accident is as important as effective remedial of accidents”.

Management follows up on a range of KPIs related to safety, which aim to improve work conditions. According to one manager, “we want to improve work conditions because we know that in the end the company will benefit”.

In this case, the process of investigation is followed, but the output of the investigation is not used to avoid the repetition of accidents. According to one manager, “we need resources in order to implement and follow up on actions to deal with the root causes of accidents”.

Autonomous (Rank 4):

Criteria for inclusion: Interviews and observations reveal that management recognizes that safety is a shared responsibility and can identify existing systems and/or practices indicating that the responsibility for accidents is shared; documentation is in place, and root cause analysis is used to define preventive measures in tandem with continuous improvement tools; communication is inclusive.

Excerpts from interviews and evidence:

The company has documentation stating that the responsibility for accidents is shared between safety and production departments, which use accident investigations and audits in order to allocate responsibility for accidents. Researchers observed that the responsibility for actions that address safety problems is shared between production and safety (some actions for improvement are allocated to production staff; other actions are the responsibility of the safety department).

Managers communicate about safety on a regular basis and consider suggestions from workers. According to one manager, “workers know a lot about why accidents happen and have very useful suggestions in order to avoid future accidents”.

Management follows up regularly on safety goals and commits resources/investments for improvement when needed. The investigation process is stable and consistently used. The root causes of accidents are identified and made available for all employees.

Way of life (Rank 5):

Criteria for inclusion (none of the 50 companies had a rank 5 in any of the practices): In rank 5, management recognizes that safety is a shared responsibility, which is integrated into the company’s strategy; participatory approaches for addressing safety problems are implemented across different organizational levels.

The whole system is considered when mapping responsibility for accidents, including the people, structure, and safety culture of the organization. There is continuous two-way communication about safety, which takes into consideration lessons learned about safety that have accumulated over time.

Safety goals are known throughout the organization. Resources for safety improvement are within the annual budget.

The process of investigation is widely used and cross-checked in different areas and levels of the organization. Moreover, root causes of accidents are consolidated and continuously used in the organization for learning and training purposes.

Appendix .1. Experts

Expert Organization	Function/Experience	Location
International Labour Organization ILO (Bangladesh)	ILO country director of Bangladesh with extensive experience in labor regulations and standards from several countries	Bangladesh
Owner 1 of garment manufacturing facilities in Bangladesh	Entrepreneur with exposure to international brands and knowledge about labor compliance standards	Bangladesh
Owner 2 of garment manufacturing facilities in Bangladesh	Entrepreneur with exposure to international brands	Bangladesh
Member 1 of Bangladesh Garment Manufacturers and Exporters Association (BGMEA)	Director responsible for relations with garment manufacturers	Bangladesh
Member 2 of Bangladesh Garment Manufacturers and Exporters Association (BGMEA)	Vice President of BGMEA with extensive knowledge of the garment manufacturing sector in Bangladesh and of the international garment market	Bangladesh
University teacher and researcher (Engineering department)	Professor with experience in supply chains and in the assessment of manufacturing operations	Denmark
University researcher (Engineering department)	Professor with experience in research related OHS	Denmark
University researcher (Engineering department)	Professor with experience in research related to productivity and OHS	Sweden

*Appendix A.2. Structure of Interviews for Each Garment Manufacturer***Table A3.** Informants.

Position	Number of Interviews	Observation
General Manager	2	The general manager was interviewed 2 times: one interview in the introductory visit and one interview to wrap up the visits
Production manager	2	The production manager was interviewed 2 times
Production supervisor	1	The production supervisor was interviewed during shop-floor tours
Production workers	1	Workers were interviewed randomly during shop-floor tours
Quality Manager	1	One formal interview with the quality manager was conducted
Quality officer	1	The quality officer was interviewed during shop-floor visits
OHS/HR Manager	1	One formal interview with the OHS manager was conducted
OHS/HR officer	1	The OHS officer was interviewed during shop-floor visits

General guidelines for the visits:

The duration of the visits varied between 2 and 3 days depending on the availability of the staff in the manufacturing facility, avoiding the first week of the month (payment period) and peak production periods within each month according to each facility. As a result, the visits were not uniformly distributed in a month. In some months, we had few or no visits at all. Moreover, the 3 days of visits were not always consecutive, depending on the availability of staff in the facility and the availability of the researchers. It is important to mention that the number of interviews in the above table are the minimum required to make the assessment. In some companies, more interviews were conducted if more data were needed.

Appendix A.3. Robustness Tests for OHS and Operational Practices

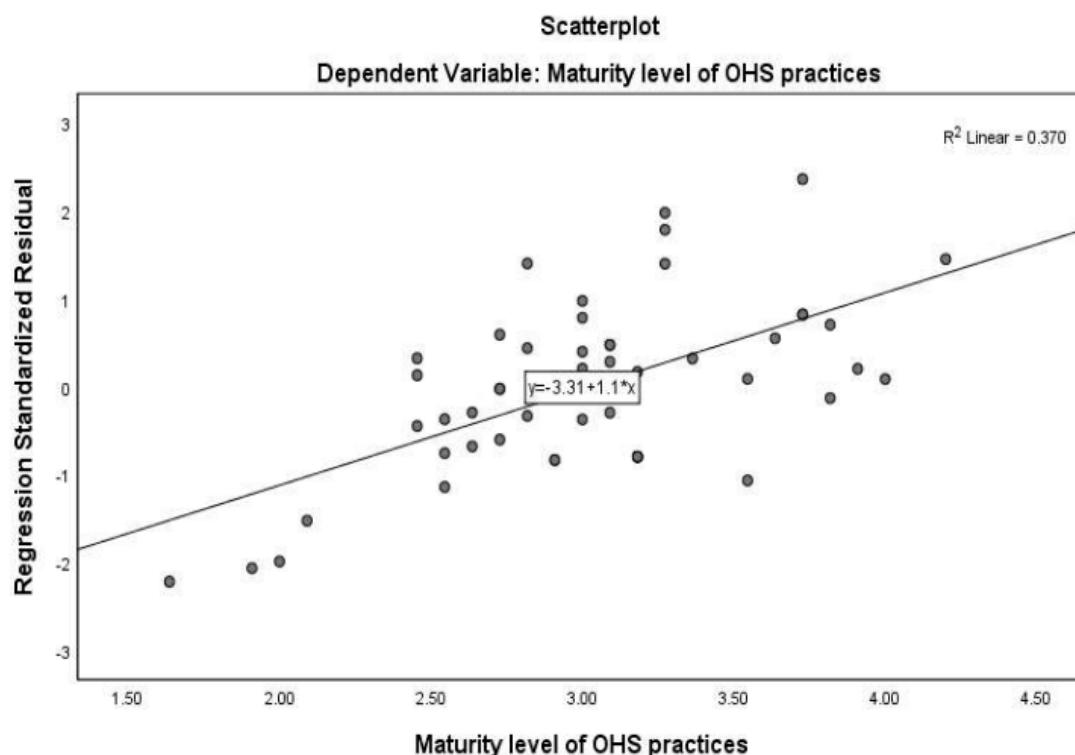


Figure A1. Scatterplot of the regression of standardized residuals.

Table A4. Skewness, kurtosis, and test of normality of the whole sample.

	Skewness	Kurtosis	Test of Normality (Shapiro–Wilk)	
Maturity level OHS	−0.149	0.088	0.983	0.686
Maturity level Operational practices	0.506	−0.649	0.944	0.019

1: Skewness is acceptable between [−1 and 1]; kurtosis is acceptable between [−2 and 2].

2: A statistically non-significant result of the Shapiro–Wilk test means that we can accept the assumption of the normality of data (at the 5% level).

Table A5. Tests to determine between-subject effects, with the maturity level of OHS practices as the dependent variable.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta-Squared	Noncent. Parameter	Observed Power b
Corrected Model	6.966 a	2	3.483	20.942	0.000	0.4571	41.884	1.000
Intercept	354.201	1	354.201	2129.641	0.000	0.978	2129.641	1.000
Plant size	6.966	2	3.483	20.942	0.000	0.471	41.884	1.000
Error	7.817	47	0.166					
Total	472.012	50						
Corrected Total	14.783	49						

a. R-squared = 0.471 (adjusted R-squared = 0.449). b. Computed using alpha = 0.05.

Table A6. Post hoc tests (maturity level of OHS practices).

	Plant Size	n	Subset	
			1	2
Scheffe a,b,c	1	9	2.3131	
	2	18		2.9697
	3	23		3.3447
	Sig.		1.000	0.059
Hochberg a,b,c	1	9	2.3131	
	2	18		2.9697
	3	23		3.3447
	Sig.		1.000	0.052

The means of groups in homogeneous subsets are displayed based on observed means. The error term is mean square (error) = 0.166. a. Uses harmonic mean sample size = 14.276. b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed. c. Alpha = 0.05.

Table A7. Tests to determine between-subject effects, with the maturity level of operational practices as the independent variable.

Source	Type III Sum of Squares	Degree Freed	Mean Square	F	Sig.	Partial Eta-Squared	Noncent. Parameter	Observed Power b
Corrected Model	8.402 a	2	4.201	20.097	0.000	0.461	40.193	1.000
Intercept	238.745	1	238.745	1142.058	0.000	0.960	1142.058	1.000
Plant size	8.402	2	4.202	20.097	0.000	0.461	40.193	1.000
Error	9.825	47	0.209					
Total	329.244	50						
Corrected Total	18.228	49						

a. R-Squared = 0.461 (Adjusted R-Squared = 0.438). b. Computed using alpha = 0.05.

Table A8. Post hoc tests for maturity level of operational practices.

	Plant Size	n	Subset	
			1	2
Scheffe a,b,c	1	9	1.9354	
	2	18	2.2229	
	3	23		2.9249
	Sig.		0.2954	1.000
Hochberg a,b,c	1	9	1.9354	
	2	18	2.2229	
	3	23		2.9249
	Sig.		0.267	1.000

The means of groups in homogeneous subsets are displayed based on observed means. The error term is mean square (error) = 0.209. a. Uses harmonic mean sample size = 14.276. b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed. c. Alpha = 0.05.

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