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Effects of Investment on Industry 4.0 implementation

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- Industry 4.0;
- Investment;
- Manufacturing;
- Technology;
- Innovation;
- Productivity.

Abstract: The governing parameters of any business for sustainable growth and development are technology and innovation. The goal of Industry 4.0 is to achieve a standardized level of productivity and operational efficiency. The fourth industrial revolution is interchangeably known as Industry 4.0, which is a control of the industrial value chain. The objective of the study is to investigate the impacts of investment on the implementation of Industry 4.0 in the manufacturing sector. A semi-structured questionnaire was used to perform the research work. The respondents were chosen based on their relevancy to the management of technology in their respective sectors. Both face-to-face interviews and web-based questionnaires were used to collect the data. The whole analysis was performed using SPSS 25 and Microsoft Office Excel 2016. The developed questionnaire was validated through consultation with academics and industrial arena experts. A hypothesis was developed to testify to the relevance of the investment with the implementation of Industry 4.0. It was observed that in the past 2 years investment of the organization for technology and innovation was about medium scale. Over the next 5 years investment of the organization for technology and innovation go through medium scale as well as large scale. In this case, the investment criteria (small, medium, large) were identified based on the percentage of the investment of total revenue.

1. Introduction

Industry 4.0 must reach the complicated level through productivity and effectiveness in order to move through the next level of automatization. The fourth industrial revolution, or "Industry 4.0," is a new phase of the industrial value chain. Due to a lack of resources, adopting new technologies is a frightening task for Small and Medium-sized Enterprises (SMEs).

Industry 4.0 is crucial for helping manufacturers with current problems because it increases their ability to adapt to market changes. Innovation that is customer-focused and has a quicker design cycle is accelerated by industry 4.0.

Bangladesh began its development as a small non-traditional export sector of RMG and manufacturing in the late 1970s. The first manufacturing facility opened its doors in 1976. For

three reasons, the sector deserves special treatment: The industry employs roughly 4.2 million people and generates (a) about 77 percent of the nation's annual foreign exchange earnings (b) the fastest growing industry in recent years. In spite of the difficulties, it has faced in the past, it has consistently displayed reliable performance, a commitment to the community, and competitive strength [1].

Innovation and technology are crucial to any organization's success. A company's technological assets are any technology that it possesses. Therefore, this asset may also include technological know-how, brainpower, hardware and software. They represent the organization's collective technical know-how, which includes its personnel, machinery, and systems [2]. For the development of a competitive strategy for a country depends on the proper linkage among investment criteria, technology and the system of trade. Therefore, it is needed to investigate the relationship between implementation of technology and innovation with investment on that particular technology.

2. Objectives of the Research

- i. To identify the effects of investment on the implementation of Industry 4.0 in manufacturing sector.

3. Literature Review

Industry 4.0 is important for the development of a country because it automates and facilitates data exchange in manufacturing-related technologies [3]. Countries with a high level of innovation and technological integration can increase their productivity and production capacity.

Uddin and Tangem's [4] mentioned that, the RMG sector accounts for more than 80% of export profits in Bangladesh as the sector is the primary source of foreign income. The purpose of the study was to identify the link between labor unrest in Bangladesh and workplace unrest in the RMG sector.

Bangladesh is one of the major nations producing apparel, competing with China. As the world adjusts to Industry 4.0, it is important to evaluate the prospects for developing nations, particularly in the ready-made garments (RMG) sector. Islam et al. [5] conducted a study on I4.0 and its potentiality in the developing countries. They identified some of the issues faced by the industry, including inadequate infrastructure, readily accessible, inexpensive labor, expensive technology setup, insufficient knowledge, and improper government support.

Ullah et al. [6] provided a summary of the current consistency management in the RMG manufacturing plants in their study. In their research, they found evidence of the value of current consistency in management practices on RMG among employers and employees.

Rantala et al [7]'s work was centered on the interaction between sustainability and adoption-related innovations. By describing the manageability factors that underlie operators' eagerness to adopt new technologies, services, and business models in their study, they close a research gap.

According to Saiful & Chandra [8], the Bangladeshi garment industry is an emerging tiger in the global economy. Their research was focused on the economy of the sector. They tried to evaluate the influence of macroenvironmental, competitive, internal, and external variables on the Bangladeshi apparel industry.

Saha & Mazumder's [9] proposed on their study, the readymade garments industry (RMG) sector serves as the economic backbone of Bangladesh and serves as a catalyst (impetus) for the development of the nation. Through the use of some significant statistical tools Analysis of variance (ANOVA), and hypothesis testing, various parameters of workplace prompting (environment leading) less efficiency of RMG industries was distinguished and analyzed in their research work.

4. Methodology

The current research is survey-based research. At first research problem was formulated. In preliminary step, appropriate research area was framed. At the same time all available literature was examined to get acquainted with the selected area. Then the research questionnaires were developed. The developed questionnaire is validated through consultation with the experts from both academics and industrial arena. Based on the collected data scientific data analysis technique is performed. To identify the relationship between investments with implementation of industry 4.0 a hypothesis for both RMG and Plastic processing industry was developed and tested.

5. Analysis and Result

5.1 Companies Investment in the Implementation of Industry 4.0

The studied organizations investment in technology and innovation management over last 2 years and next 5 years are depicted respectively in figure 1 and 2. Here, investment of the organizations for technology and management in the past 2 years was about medium scale. Over the next 5 years organizations investment in technology and management sector is moving towards medium scale to some extent in large scale. Investments have been categorized as small, medium and large based on the percentage being invested of the total revenue. Investment that is <5% as small scale, <10% as medium scale and >10% as large scale.

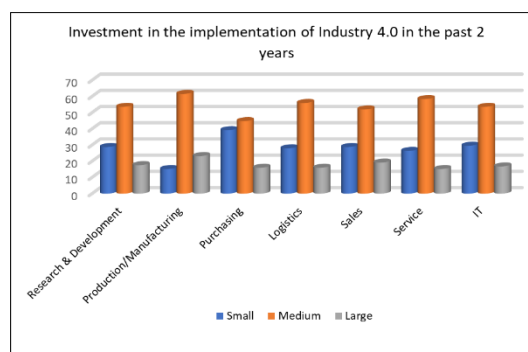


Figure 1: Investment status in the past 2 years

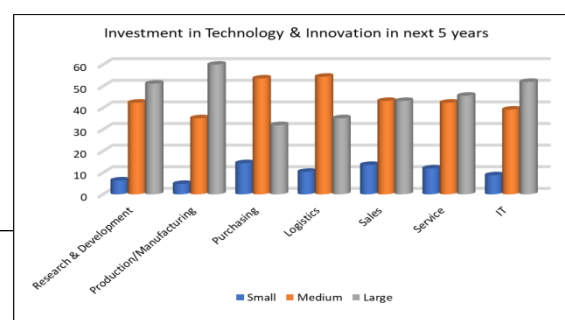


Figure 2: Investment status in the next 5 years

5.2 Analysis of the Hypothesis

Figure 3 illustrates the link between Implementation of industry 4.0 with the Investment of the organizations.

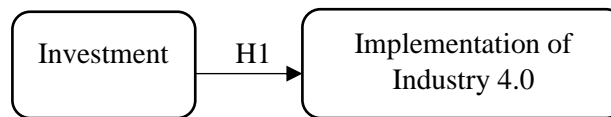


Figure 3: The Conceptual Model.

Hypothesis:

Null Hypothesis (H₀): Investment has an impact on implementation of I4.0.

Alternative Hypothesis (H_A): Investment has no impact on implementation of I4.0.

Investment in the required departments of the studied factories like Research & Development, Production, Purchasing, Logistics, Sales, Services, IT etc. with proper synchronization for the implementation of I4.0.

Hypothesis analysis for RMG

Table 1: Model Fitting Information

Model Fitting Information				
Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 log likelihood	Chi-square	df	Sig. (α)
Intercept only	179.356			
Final	4.159	175.197	112	0.000

Using the chi-square statistic, the model fitting was assessed. Probability of a statistical hypothesis test is p-value. The p-value is greater than 0.05 so, the null hypothesis is accepted.

Table 2: Goodness of Fit test

Goodness of Fit			
	Ch-square	df	Sig.

Pearson	0.000	136	1.000
Deviance	0.000	136	1.000

From this table Pearson & Deviance chi-square indicates the model is fit [$p = 1.00$]. So, this test is statistically significant.

Table 3: Pseudo R-square

Pseudo R-square	
Cox and Snell	0.915
Nagelkerke	0.990
McFadden	0.955

The model accounts for 95.5% to 99% of the variance and represents relatively decent-sized effects.

Likelihood Ratio Test

The independent variables of hypothesis were significant, which proves that these predictors contribute significantly to the final model.

Hypothesis analysis for Plastic Product Manufacturing

Table 4: Model Fitting Information

Model Fitting Information				
Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 log likelihood	Chi-square	df	Sig. (α)
Intercept only	65.884			
Final	3.008	62.876	57	0.276

Using the chi-square statistic, the model fitting was assessed. Probability of a statistical hypothesis test is p-value. The p-value is greater than 0.05 so, the null hypothesis is accepted.

Table 5: Goodness of Fit test

Goodness of Fit			
	Ch-square	df	Sig. (α)
Pearson	0.000	12	1.000
Deviance	0.000	12	1.000

From this table Pearson & Deviance chi-square indicates the model is fit [$p = 1.00$]. So, this test is statistically significant.

Table 6: Pseudo R-square

Pseudo R-square	
Cox and Snell	0.877
Nagelkerke	0.973
McFadden	0.905

The model accounts for 90.5% to 97.3% of the variance and represents relatively decent-sized effects.

6. Discussion

The whole analysis is based on the Manufacturing Industries of Bangladesh. At the investment phase, it seems that, investment of the organizations for technology and management in the past 2 years was about medium scale which is seen in the next 5 years moving towards large scale. This is the reflection that the manufacturing sector is not yet ready to adopt industry 4.0 from the perspective of investment.

7. Conclusion

From the obtained results it can be concluded that,

- i. Investment indicates that the selected industrial sector is not yet ready.
- ii. There is a strong relationship between investment and implementation of industry 4.0

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