

Barriers of Medical Equipment Manufacturing from the Perspective of Bangladesh Using Analytical Hierarchy Process

Md. Hassib Hasan, Md. Abdullah-Al-Riadh, Md. Rasel Sarkar

Department of Industrial & Production Engineering,

Rajshahi University of Engineering & Technology, Rajshahi-6204

E-mail: hassib.ipe19.18@gmail.com, abdullahalriadh26@gmail.com, rasel@ipe.ruet.ac.bd

Abstract

Bangladesh, a developing country imports a lot of medical equipment each year from different countries. Very little amount of medical equipment is manufactured within the country. This study investigates the barriers of manufacturing of medical equipment in Bangladesh. The objective was to identify, rank, and analyse the key obstacles hindering the industry's growth. From the extensive literature review and surveys conducted among manufacturing industries, medical students, doctors, and diagnostic centres 21 significant barriers were identified primarily.

Analytical Hierarchy Process (AHP) method was used to analyse the barriers. The AHP framework was then used to pairwise comparisons, calculating weights, and performing consistency checks of these barriers. Finally, the barriers were ranked using AHP method. The most critical barriers were found as regulatory challenges, limited skilled manpower, and inadequate infrastructure. Moderately significant issues include limited domestic investment, risk-averse management practices, supply chain complexities, and lack of collaboration between private and public organizations. Analysing these factors suggestions had been given to overcome these barriers. Future research should focus on creating policies to simplify regulations, encouraging partnerships between public and private sectors, and developing training programs to address skill shortages. Efforts should also explore ways to improve infrastructure and assess the long-term impact of these measures to guide further action.

This research contributes valuable knowledge to the field by highlighting the primary barriers to medical equipment manufacturing in Bangladesh. Addressing these challenges is essential for advancing the industry and ensuring its ability to meet both domestic and international demands.

Keywords: Medical Equipment, Analytical Hierarchy Process (AHP), Barrier Analysis, Regulatory Challenges manufacturing industries.

1. Introduction

Despite being a fundamental human right, many people in Bangladesh struggle to access adequate medical services. According to the **World Health Organization** this country with a population of approximately 164 million ranks 88th globally in healthcare quality. This inadequacy forces around 700,000 individuals to seek treatment abroad each year resulting in expenditures of approximately USD 3.5 billion [4]. A significant contributor to this issue is the lack of sufficient medical equipment. Only 5-7% is manufactured domestically [4]. The COVID-19 pandemic has further affected local production capabilities. This study aims to identify the barriers which hinder medical equipment manufacturing in Bangladesh and rank them. This paper offers valuable insights for policymakers and stakeholders in the sector.

The manufacturing and procurement of medical equipment in Bangladesh face significant issues. The key barriers include limited resources, inadequate infrastructure, and a severe shortage of skilled personnel. The heavy reliance on imported medical technology often results in equipment that is either unsuitable for local needs or under-utilized in the healthcare industry. Also, the inefficiencies in this sector led to a considerable proportion of procured devices remaining unused or quickly becoming non-functional due to mismatches with local conditions. These obstacles strain the healthcare system and affect the delivery of effective services. Addressing these challenges is crucial for improving healthcare quality in Bangladesh. Because efficient and context-appropriate

medical equipment can enhance diagnostic and treatment capabilities, reduce costs, and increase access to quality healthcare services. This study is being conducted to systematically identify and analyse the barriers affecting medical equipment manufacturing in Bangladesh. The goal is to provide actionable insights to develop this sector.

The Analytical Hierarchy Process (AHP) was chosen for this study as it offers a robust, structured framework to analyze and rank complex, multi-criteria problems. AHP allows for pairwise comparisons of barriers, enabling a systematic evaluation of their relative significance based on expert opinions. This method also ensures consistency in analysis, making it well-suited for prioritizing barriers in an under-researched field like medical equipment manufacturing in Bangladesh.

Research Objectives:

1. To identify the key barriers to medical equipment manufacturing in Bangladesh.
2. To analyze and rank these barriers using the Analytical Hierarchy Process (AHP).
3. To provide actionable recommendations to address these challenges.

2. Problem Statement

The medical equipment manufacturing sector in Bangladesh faces significant barriers, including regulatory hurdles, inadequate infrastructure, and a shortage of skilled professionals. These challenges limit the sector's growth and competitiveness, resulting in dependency on imported medical equipment to meet domestic demand. Furthermore, the lack of structured research into the prioritization of these barriers creates difficulties in devising effective solutions. This study aims to analyze and prioritize the critical barriers using the Analytical Hierarchy Process (AHP) to propose actionable recommendations for overcoming these challenges.

3. Review of literature

The medical equipment manufacturing sector encounters a variety of regional challenges, each offering valuable lessons that could benefit Bangladesh. In India, the industry grapples with regulatory uncertainties and fragmented market access, which impede growth. A study involving semi-structured interviews with stakeholders in the diagnostics sector underlines the need for specific interventions to navigate these hurdles [1]. In China, the high-end medical equipment sector faces significant obstacles in core technology shortages and weak innovation capabilities, further strained by the COVID-19 pandemic. This situation calls for comprehensive assessments and strategic planning to address these challenges [2].

In Cuba, the medical device industry contends with stringent regulatory demands and non-tariff barriers that restrict international trade, pointing to the importance for local manufacturers to adapt to complex market dynamics to thrive internationally [3]. Research targeting low- and middle-income countries indicates that local production of medical devices can greatly improve access, though it also faces issues such as inadequate governance, lax regulations, and elevated production costs. These findings highlight the critical role of supportive policies and financing mechanisms to foster local manufacturing [4]. Lastly, an analysis of the total cost of ownership in medical device procurement reveals the overlooked critical cost factors in traditional procurement markets, emphasizing the necessity for a thorough cost analysis to enhance decision-making processes [5].

From the above literature review it appears important to systematically identify, categorize and analyse the key barriers on the growth and sustainability of the medical equipment manufacturing sector in Bangladesh. Also, to formulate actionable recommendations for policymakers and industry stakeholders to enhance the medical equipment manufacturing sector for promoting local production capabilities and reducing reliance on imported medical devices.

4. Methodology

The Analytical Hierarchy Process (AHP) is employed as a structured decision-making tool to prioritize barriers in the medical equipment manufacturing sector. This method involves pairwise comparisons of identified barriers, drawing on expert consultations and survey findings to determine their relative importance. Complementing this, a survey methodology is utilized, gathering insights from medical students, doctors, and diagnostic center employees who rate 21 predefined barriers on a scale of 1 to 5. This provides a comprehensive perspective on the challenges prevalent in the sector. Additionally, a thorough literature review of scholarly articles and publications related to barriers in medical equipment manufacturing in various contexts, including countries like India, China, and Cuba, helps to identify common obstacles. The data from the surveys are then analyzed using AHP, which

aids in generating priority weights for each barrier, thereby facilitating a systematic understanding of their impact on the manufacturing processes.

5. Data Analysis

Utilized the AHP framework to analyse pairwise comparisons and derive priority weights for each barrier criterion, generating a final ranking reflecting their relative significance in impeding medical equipment manufacturing in Bangladesh. A survey methodology is utilized, gathering insights from medical students, doctors, and diagnostic center employees, in total 19 professionals who rate 21 predefined barriers (**Table 5.1**) on a scale of 1 to 5.

Table 6.1: Selected 21 Barriers from Literature Review

Sl.	Barriers	References
1	Regulatory Body Demands	[1], [4]
2	International Quality Standards Meeting	[1], [2]
3	Assuring Efficient Quality and Testing	[3]
4	Government Procedures Interactions	[3], [4]
5	Skilled Workforce Shortage	[4], [5]
6	Inadequate Infrastructure (including reliable power and water)	[3], [5]
7	Insufficient Domestic Investment	[3], [5]
8	Difficulties in Obtaining Finance	[3], [5]
9	Lack of Collaboration between Private and Public Organizations	[2], [3]
10	Insufficient Government Policies	[3], [4]
11	Lack of Collaboration between Academia and Manufacturers	[2], [4]
12	Availability of Domestic Market (limited demand)	[2], [3]
13	Prejudice against Local Manufacturing	[4], [5]
14	Import-Export Taxation Rules	[1], [3]
15	Restriction on Foreign Investment	[4]
16	Low Technological Transformation Rate	[3], [5]
17	Poor Risk Taking by Top Management	[2], [5]
18	Over Dependence on Input-Output Model	[2], [3]
19	Supply Chain Complexity	[3], [5]
20	Lack of Biomedical Engineers and Institutions	[4], [5]
21	Corruption	[2], [4]

6. Result

The results of our case were determined using the AHP method and detailed data analysis to identify the most significant barriers (**Table 6.1**). This chapter presents the key barriers identified in our case study that need to be addressed. While the study offers valuable insights, it has some limitations, such as a possibly non-representative sample size and the subjective nature of AHP. Despite these limitations, the detailed survey data combined with AHP provides a thorough analysis of the barriers in medical equipment manufacturing, which is useful for policymakers and industry leaders.

To identify the barriers affecting medical equipment manufacturing in Bangladesh, we gathered data from medical students, doctors, and diagnostic center workers. We designed a detailed survey where participants rated 21 predefined barriers on a scale from 1 to 5, based on their impact on manufacturing. Questions addressed issues like regulatory challenges, skilled manpower, infrastructure, government policies, public-private collaboration,

quality standards, market availability, technological transformation, management practices, local prejudices, collaboration with academic institutions, import dependence, and financial and procedural barriers. Using the Analytical Hierarchy Process (AHP), we ranked these barriers. This involved pairwise comparisons of barriers to determine their relative importance, calculating weights from these comparisons, and performing a consistency check to ensure reliability. The analysis highlighted the most critical issues, such as regulatory challenges, limited skilled manpower, and inadequate infrastructure.

Table 6.1: Ranked Barriers from AHP analysis

Barriers	Weighs	Criteria Weighs
Limited Demand	1.39220431	0.066295443
Inadequate Infrastructure	1.38183923	0.065801868
Regulatory Body Demands	1.38017142	0.065722449
Import-Export Taxation Rules	1.24295088	0.059188137
Prejudice against Local Manufacturing	1.16505949	0.055479023
Insufficient Domestic Investment	1.11809711	0.05324272
Poor Risk Taking by Top Management	1.09191732	0.051996063
Skilled Workforce Shortage	1.05190413	0.050090673
Supply Chain Complexity	1.0411195	0.049577119
Private and Public Organizations collaboration lack	1.00782763	0.047991792
Government Procedures Interactions	0.95235143	0.045350068
Corruption	0.93325145	0.044440545
Over Dependence on Input-Output Model	0.89533	0.042634762
Difficulties in Obtaining Finance	0.8671881	0.041294671
International Quality Standards Meeting	0.8488515	0.0404215
Restriction on Foreign Investment	0.84870497	0.040414522
Academia and Manufacturers collaboration lack	0.81346689	0.038736519
Insufficient Government Policies	0.764129	0.036387095
Low Technological Transformation Rate	0.75859394	0.036123521
Lack of Biomedical Engineers and Institutions	0.72580599	0.03456219
Assuring Efficient Quality and Testing	0.71923569	0.034249319

7. Conclusion

This study has systematically outlined the significant barriers impeding the medical equipment manufacturing industry in Bangladesh. The findings reveal that regulatory challenges, infrastructural deficiencies, skill shortages, quality compliance issues, and negative market perceptions are the principal obstacles. Addressing these barriers requires a concerted effort from both government and private sectors to implement reforms that streamline regulations, improve infrastructure, and enhance workforce skills. By overcoming these challenges, Bangladesh can foster a robust medical equipment manufacturing sector that supports improved healthcare accessibility and quality.

8. Discussion

The application of the Analytical Hierarchy Process (AHP) provided a structured approach to identify and prioritize key barriers. This method enabled a quantifiable analysis that reflects the relative importance of each barrier as perceived by stakeholders within the sector. The discussion highlights the interconnected nature of these barriers, where regulatory improvements, infrastructural enhancements, and educational advancements are seen not as isolated initiatives but as complementary components of a strategic overhaul. Addressing these systematically can significantly improve the manufacturing landscape and, by extension, healthcare outcomes in

Bangladesh. Managers must focus on strategic planning to streamline regulatory compliance. They should invest in workforce training and strengthen supply chain networks. Collaboration with public organizations can unlock resources and create innovation opportunities. Additionally, efforts to improve market perceptions of local equipment through quality assurance and R&D can position firms competitively in domestic and global markets.

9. Significance of the Study

This study is significant for policymakers, industry stakeholders, and academics as it provides critical insights for effective regulatory frameworks and strategic interventions. By utilizing the Analytical Hierarchy Process (AHP) to prioritize these barriers, the research aims to weigh the impact each possess toward manufacturing locally. Ultimately, the findings contribute to improving healthcare access and quality, positively impacting public health outcomes.

10. Future Work

Future research should focus on several areas such as:

1. **Technological Integration:** Investigating the role of advanced technologies, such as artificial intelligence and robotics, in optimizing manufacturing processes and enhancing product quality.
2. **Policy Impact Studies:** Conducting longitudinal studies to assess the impact of specific policy changes on the medical equipment manufacturing sector. Institutional education on BME should be increased.
3. **Comparative International Studies:** Examining successful strategies from other countries that have bolstered their local manufacturing sectors to identify applicable lessons and best practices.
4. **Market Development Strategies:** Exploring effective marketing strategies that can change the current market perceptions of locally manufactured medical equipment.
5. **Sustainability Practices:** Evaluating the integration of sustainable practices in the manufacturing process and their impact on both the environment and product acceptability in the market.
6. **Collaborating with the professionals:** In BME institutions consultancy among engineers, doctors and technicians must be in the priority list.
7. **Collaborating with Companies:** Govt should collaborate with foreign companies and use their expertise in this sector. Even native companies can also do the same thing.

11. References

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