Feasibility Analysis of Convection Factory at *Pesantren* Al Bahjah

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Abstract*—Due to inconsistent and delayed uniform supplies from outside vendors, Pondok Pesantren Al Bahjah, a well-known Islamic education institution in West Java, plans to develop a convection factory. This study carries out a thorough feasibility analysis to assess the feasibility of establishing an internal convection factory as a calculated move towards operational stability and self-sufficiency. The project is evaluated from three important aspects: market, technical, and financial. Historical demand data from 2022 to 2025 is used to forecast the demand, technical design is benchmarked against an established convection company, and standard investment appraisal metrics like Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP) are used. The project's feasibility is confirmed by the study, which also finds a steady internal demand and a sizable chance to make use of idle capacity by manufacturing Muslim clothing for external markets. Using Minimum Attractive Rate of Return (MARR) of 17.05%, the financial evaluation estimates a positive net present value (NPV) of Rp134,283,523, an internal rate of return (IRR) of 26.83%, and a PBP of 3.58 years, meaning the project is feasible. The project's resistance to operational and market risks is further confirmed by a sensitivity analysis.

Keywords*—Feasibility Study, Convection Factory, Pondok Pesantren, Uniform Fulfillment

I. INTRODUCTION

As an essential aspect of institutional identity and discipline, school uniforms have great significance in Indonesia's educational system, especially at its Pondok Pesantren (Islamic boarding schools). The Ministry of Education, Culture, Research, and Technology's Regulation Number 50 of 2022 emphasises how important uniforms are for discipline, developing nationalism, and enhancing the institution's reputation. Consequently, as more students join in school, the need for uniforms keeps growing. However, because Pesantren Al-Bahjah and other institutions depend on external vendors for consistent procurement, they often face significant operational difficulties.

There has been an ongoing annual need for thousands of uniform pieces (e.g., 3,378 units expected for 2026) due to the continuous enrolment of new students in Al-Bahjah, which is located in West Java, a province with a large concentration of *pesantren*. The present external procurement strategy suffers from inefficiencies in spite of this predicted demand. Among the main problems are irregular pre-order scheduling, which frequently occurs too close to the start of the school year; poor communication and excessive coordination with several suppliers; and supplier overload at busy times like Ramadan and Eid, which causes Al-Bahjah's orders to lose priority. The operational efficacy and readiness of the school are impacted by the frequent and disruptive delays in uniform supply caused by these factors taken together.

Standardised procurement methods and strategic supplier consolidation plans are examples of partial solutions that may help with certain symptoms, but they fail to offer a thorough fix for the root causes. According to this analysis, establishing an internal, privately held convection factory for Pesantren Al-Bahjah is a long-term, calculated solution. By internalising production control, removing reliance on external vendors, and securing dedicated manufacturing capacity, such an initiative would ensure institutional self-sufficiency and operational stability.

There is a noticeable lack of academic study on the operational difficulties encountered by the factory in this pesantren, especially with regard to consistent supply, despite the fact that supply chains and logistical concerns are crucial for the factory. By offering a thorough feasibility analysis that is adapted to the unique circumstances and requirements of Pesantren Al-Bahjah, this study seeks to close this gap by covering market, technical, and financial aspects. Since the uniform fulfilment problem occurs every year and has a direct effect on Al-Bahjah's operational responsibilities and reputation, this feasibility analysis is carried out to offer a solid, evidence-based justification for strategic decision-making prior to making investments in physical infrastructure. In addition to solving a crucial supply chain weakness, improving operational autonomy, ensuring quality control, and maybe providing an applicable model for other educational institutions dealing with comparable issues, the findings provide a data-driven justification for investment.

II. THEORETICAL BASIS

The ideas of a business feasibility study, which methodically assesses a project's likelihood of success, serve as the foundation for this study. A feasibility study is a thorough examination of a prospective business that looks at its technical, financial, and market aspects in order to assess its potential [1].

A. Elements of a Feasibility Study

1. Market Aspect: In order to evaluate opportunities, this entails examining market demand and segmentation. To properly position the offering,

it involves estimating demand and creating a marketing mix (Product, Price, Place, Promotion) [2].

2. Technical Aspect: This assesses a project's operational needs, such as location, factory layout, technology, machinery, and personnel. Efficiency, safety, and scalability are ensured by an ideal technical design [3].
3. Financial Aspect: This evaluates a project's economic feasibility using investment assessment and financial estimates. Preparing pro forma financial accounts (income statement, balance sheet), projecting cash flows, and evaluating investment expenses are important elements [4].

B. Investment Appraisal Methods

Financial feasibility is assessed using a number of standard metrics:

1. Net Present Value (NPV): Determines the difference between the original investment and the present value of future cash inflows. A profitable project is indicated by a positive net present value [5].
2. Internal Rate of Return (IRR): The discount rate at which a project's net present value drops to zero. If a project's internal rate of return (IRR) is higher than its minimum attractive rate of return (MARR), it is deemed feasible [5].
3. Payback Period (PBP): The amount of time needed for an investment to produce enough cash flows to pay its original investment [4].
4. Profitability Index (PI): The ratio between the initial investment and the present value of future cash flows. A project is considered feasible if its PI is larger than 1 [5].

C. Sensitivity and Risk Analysis

Sensitivity analysis is used to ascertain how changes in important factors (such as material costs and sales volume) impact the financial results of a project. By identifying and measuring the uncertainties that can affect the project's success, risk analysis enables the creation of mitigation plans [6].

III. METHODOLOGY

This study conducts a thorough feasibility analysis using a multi-phase, organised methodology. The procedure combines the collection, analysis, and processing of data from technical, financial, and market aspects.

1. Preliminary Phase: The study started by using interviews and a root-cause analysis to determine the primary root cause of inconsistent uniform delivery at Al-Bahjah. The theoretical foundation for feasibility studies was established by an overview of existing literatures.
2. Data Collection Phase:
   - Market data: Al-Bahjah provided historical internal statistics on student enrolment and uniform orders for the years 2022–2025. E-commerce sites (Shopee) provided information on the external Muslim fashion industry in order to evaluate potential uses of idle capacity.
   - Technical Data: To collect information on business procedures, production capacity, factory layout, and machinery needs, a benchmarking research was carried out on CV. Raval Garmindo, an established convection factory. Potential factory locations in Cirebon were evaluated.
   - Financial Data: Supplier price estimates, internet marketplaces, and official government sources were used to gather information on the costs of raw materials, labour (adjusted for Cirebon's regional minimum wage), machinery, rent, and other operating expenditures.
3. Data Processing and Analysis Phase:
   - Market Analysis: The basic linear regression approach was used to predict the demand for school uniforms. A 4P marketing mix plan was created for both internal and external products.
   - Technical Analysis: A factor-rating approach was used to choose the best factory location. Requirements for labour, facilities, and machinery were determined by the demands for production capacity. An efficient factory layout plan was created.
   - Financial Analysis: Pro forma financial statements were created, including the balance sheet, cash flow, and income statement. With a computed MARR of 17.05%, the project's feasibility was assessed using NPV, IRR, PBP, and PI metrics. Additionally, a sensitivity and risk analysis was carried out.

IV. RESULTS AND DISCUSSION

Positive results from technical, financial, and market analysis validated the feasibility of establishing a Al-Bahjah's proposed convection factory.

A. Market Feasibility

With a projected demand of 3,378 units of school uniform items in 2026 (see Table 2), the study of internal historical data predicted an ongoing demand for school uniforms. A baseline production load is assured by this internal market.

A strategy of make-to-stock for external products was devised in order to make use of the factory's idle capacity outside of the one-month uniform production window.

Shopee sales data was used to determine the popularity rankings of the following Muslim fashion items: Baju Koko, Mukenah, Jubah Pria, Gamis Wanita, and Kerudung Bergo. This approach targets Indonesia's sizable and expanding Muslim consumer market and enables the proposed factory to earn revenue all year round.

Table 2. Forecasted Demand of School Uniform Items (2026-2029)

Forecasted Demand of School Uniform Items			
2026	2027	2028	2029
3378	3326	3274	3222

B. Technical Feasibility

The operational framework, including strategic choice of location, optimal factory layout, effective workflow design, and precise determination of machinery, equipment, and human resources, is carefully outlined in the technical feasibility analysis for the establishment of the Pesantren Al-Bahjah convection factory.

1. Location Selection

Figure 1. Proposed Factory Building (Weru, Cirebon)

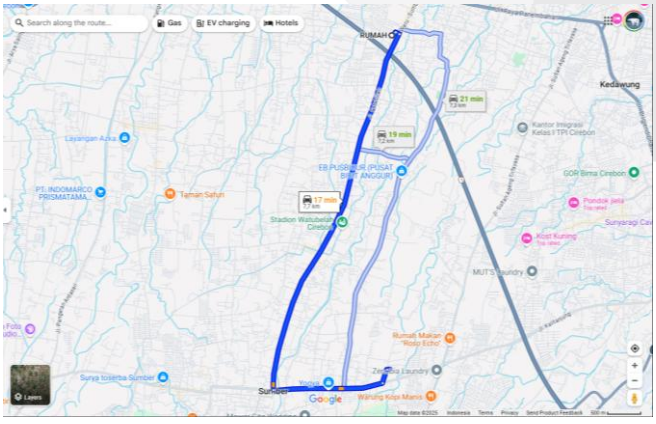

Figure 2. Distance of Proposed Factory Building to Al-Bahjah

The proposed factory will be positioned strategically in Weru, Cirebon, having been selected following a thorough analysis of several important factors:

- Cost-effective Rent: When compared to other possibilities, the chosen location offers the most favourable yearly rent (Rp80,000,000), which significantly reduces initial fixed overheads.
- Proximity to Pondok Pesantren Al-Bahjah: The location ensures timely delivery of school uniforms and logistical efficiency, which is a crucial operating necessity, as it is only 7.7 km away from Pondok Pesantren Al-Bahjah.
- Sufficient Space for manufacturing: The 375 m² building in Weru, Cirebon, is well sized to accommodate the planned manufacturing floor, which requires 247 m².

2. Factory Layout

Table 3. Color-Coded Areas

Color-Coded Areas			
: Raw Materials		: Steam Ironing	
: Pattern Making, Cutting		: Equipment Storage	
: Sewing, Overlock, Button Punching, QC		: Finished Goods	
		: Office	

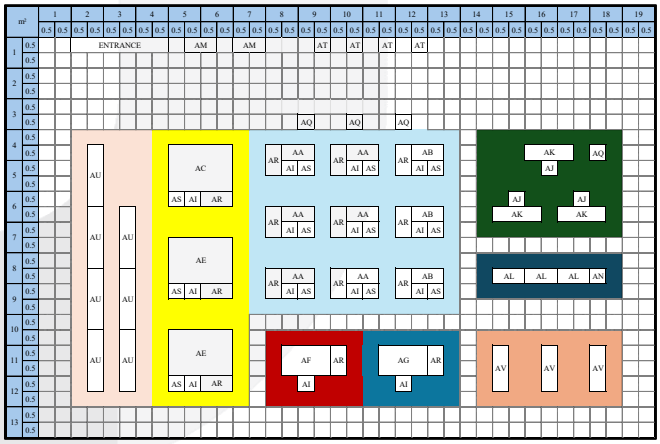

Figure 3. Proposed Factory Layout

The factory layout, which is 19 meters by 13 meters and has a total area of 247 m², was created using Microsoft Excel. All necessary equipment and facilities are carefully positioned with a base area in this grid-based design, ensuring efficient workflow and maximum space utilisation. The design reduces needless movement and maximises efficiency by allowing materials and products to move smoothly through the many phases of production.

3. Workflow and Human Resources

Related processes are positioned next to each other in the workflow, which is intended for integrated and effective production. Pattern making, fabric cutting, stitching, overlocking, buttonhole creation, button attachment, quality control, steam ironing, and packaging are all included in this. The activities are ensured to proceed effectively and continuously due to this sequential structure.

The workflow needs and production capacity are closely connected with the human resource strategy. There are 14 workers in total: 11 direct labourers and 3 management personnel (Product Manager, Admin, and Finance). The production capacity ratio of the benchmark company to the proposed factory determines the number of direct labourers for each workstation, guaranteeing that there is enough workers for each specialised activity. To ensure a one-to-one labor-to-machine ratio for core processes, for example, six sewing machines are assigned if six sewers are required to reach output requirements. The objective of this specialisation is to decrease any bottlenecks seen in benchmarked firms and increase productivity.

Table 4. Number of Direct Labor

Number of Direct Labor	
Role	Quantity
Patter Maker	1
Fabric Cutter	2
Sewer	6
Overlock Operator	Done by Sewers
Buttonhole Maker	
Quality Control	
Steam Ironing	1
Packer	1
Total	11

Table 5. Number of Indirect Labor

Number of Indirect Labor	
Role	Quantity
Production Manager	1
Admin	1
Finance	1
Total	3

4. Machinery, Equipment, and Facilities

The established labour requirements and production volume have a direct impact on the choice and amount of facilities, machinery, and equipment. Essential pieces of equipment include steam irons (1 unit), buttonhole punching tools (6 units), overlock machines (3 units), sewing machines (6 units), and fabric cutting machines (2 units). Additionally listed are necessary facilities like packaging tables (1 unit), fabric cutting tables (2 units), and patterning tables (1 unit). This substantial investment, which comes to Rp85,632,798, ensures that the factory has all the resources it needs to meet the projected production demands for both external products and school uniforms, without the need for additional expenditures in machinery or infrastructure.

Table 6. Machines and Equipment

Main Machines and Equipment	
Type of Machine and Equipment	Quantity
Fabric Cutting Machine	2
Sewing Machine	6
Overlock Machine	3
Buttonhole Punching Tool	6
Steam Iron	1

Table 7. Specialized Workstations

Specialized Workstations	
Type	Quantity
Pattern Making Table	2
Fabric Cutting Table	6
Packing Table	3

5. Idle Capacity Utilization

The idle capacity of the proposed convection factory, which results from the production of school uniforms needing just 24 working days in June each year, is strategically addressed. The factory will utilize its excess capacity to create a range of external Muslim fashion items for the external market over the remaining 11 months. The substantial market potential in Indonesia's Muslim fashion industry (estimated at USD 20 billion with an annual growth rate of 18.2%), high production compatibility with current labour and equipment (no additional investment needed), and raw material efficiency (using the same fabrics and supporting materials as uniforms) are the main drivers of this strategy.

Table 6. Production Schedule Before Idle Capacity Utilization

	Production Schedule of Al-Bahjah School Uniforms			
	in 2026	in 2027	in 2028	in 2029
June	3,378	3,326	3,274	3,222
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	-	-	-	-
December	-	-	-	-
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	-	-	-	-
May	-	-	-	-

Table 7. Production Schedule Before Idle Capacity Utilization

	Production Schedule of Al-Bahjah Convection Factory			
	in 2026	in 2027	in 2028	in 2029
June	3,378	3,326	3,274	3,222
July	2,879	2,879	2,879	2,879
August	2,879	2,879	2,879	2,879
September	2,879	2,879	2,879	2,879
October	2,879	2,879	2,879	2,879
November	2,879	2,879	2,879	2,879
December	2,879	2,879	2,879	2,879
January	2,879	2,879	2,879	2,879
February	2,879	2,879	2,879	2,879
March	2,879	2,879	2,879	2,879
April	2,879	2,879	2,879	2,879
May	2,879	2,879	2,879	2,879

C. Financial Feasibility

1. Pro Forma Income Statement

The project's anticipated revenues, direct costs, factory overheads, and operating costs are all included in the Income Statement, which also provides an estimate of Earnings After Interest and Tax (EAIT) for 2026–2029.

Table 8. Pro Forma Income Statement

Year	2026	2027	2028	2029
Income				
Sales Revenue	Rp4,338,575,890	Rp4,402,546,427	Rp4,467,453,346	Rp4,533,310,234
Total Income	Rp4,338,575,890	Rp4,402,546,427	Rp4,467,453,346	Rp4,533,310,234
Direct Cost				
Direct Raw Material Cost	Rp3,508,806,220	Rp3,557,460,037	Rp3,606,801,006	Rp3,656,781,236
Direct Labor Cost	Rp432,574,607	Rp431,932,787	Rp431,290,966	Rp430,649,146
Total Direct Cost	Rp3,941,380,827	Rp3,989,392,823	Rp4,038,091,972	Rp4,087,430,381
Factory Overhead Cost				
Indirect Labor Cost	Rp96,529,768	Rp98,074,244	Rp99,643,432	Rp101,237,727
Indirect Raw Material Cost	Rp8,509,600	Rp8,645,754	Rp8,784,086	Rp8,924,631
Rent Expense	Rp80,000,000	Rp81,280,000	Rp82,580,480	Rp83,901,768
Electricity Expenses	Rp17,103,892	Rp17,103,892	Rp17,103,892	Rp17,103,892
Water Expenses	Rp3,600,000	Rp3,600,000	Rp3,600,000	Rp3,600,000
Machinery and Facilities Investment Costs	Rp0	Rp0	Rp0	Rp0
Machine Depreciation Cost	Rp3,756,850	Rp3,756,850	Rp3,756,850	Rp3,756,850
Facility Depreciation Cost	Rp14,694,475	Rp14,694,475	Rp14,694,475	Rp14,694,475
Internet Expenses	Rp3,600,000	Rp3,657,600	Rp3,716,122	Rp3,775,580
Consumable Cost	Rp352,800	Rp358,445	Rp364,180	Rp370,007
Waste Expenses	Rp3,300,000	Rp3,352,800	Rp3,406,445	Rp3,460,948
Maintenance Cost	Rp366,000	Rp371,856	Rp377,806	Rp383,851
Total Overhead Factory Cost	Rp231,813,385	Rp234,895,915	Rp238,027,767	Rp241,209,727
Total Cost of Goods Sold	Rp4,173,194,212	Rp4,224,288,739	Rp4,276,119,739	Rp4,328,640,109
Gross Profit (Income Before Operation)	Rp165,381,678	Rp178,257,688	Rp191,333,607	Rp204,670,125
Operational Cost				
Marketing Expenses	Rp3,175,700	Rp3,226,511	Rp3,278,135	Rp3,330,586
Holiday Allowance Expenses (*THR*)	Rp44,092,031	Rp44,167,253	Rp44,244,533	Rp44,323,906
Total Operational Cost	Rp47,267,731	Rp47,393,764	Rp47,522,669	Rp47,654,492
EBT (Earning Before Tax)	Rp118,113,946	Rp130,863,924	Rp143,810,939	Rp157,015,634
TAX 0.5%	Rp590,570	Rp654,320	Rp719,055	Rp785,078
EAIT (Earning After Interest and Tax)	Rp117,523,377	Rp130,209,605	Rp143,091,884	Rp156,230,555

2. Feasibility Analysis Results

Table 9. Feasibility Analysis Results

Year	2025	2026	2027	2028	2029
Period	0	1	2	3	4
Machine and Equipment Investment	-Rp85,632,798	Rp -	Rp -	Rp -	Rp -
Working Capital	-Rp124,925,564	Rp -	Rp -	Rp -	Rp124,925,564
Earning After Tax	Rp -	Rp117,523,377	Rp130,209,605	Rp143,091,884	Rp156,230,555
Add Back Depreciation	Rp -	Rp18,451,325	Rp18,451,325	Rp18,451,325	Rp18,451,325
Net Cash	-Rp510,558,362	Rp135,974,702	Rp148,660,929	Rp161,543,209	Rp599,607,444
p/f Factor 17.05%	1.00	0.85	0.73	0.62	0.53
NPV	-Rp510,558,362	Rp116,168,049	Rp108,506,063	Rp100,733,622	Rp319,434,150
NPV Cumulative	-Rp510,558,362	-Rp394,390,313	-Rp285,884,249	-Rp185,150,627	Rp134,283,523
	MARR	17.05%			
	NPV	Rp134,283,523			
	Payback Period	3.58			
	Profitability Index	1.26			
	IRR	26.83%			

Based on the feasibility analysis results, the proposed project's financial analysis shows overall feasibility. With a positive Net Present Value (NPV) of Rp134,283,523, the project is anticipated to provide value. It is anticipated that the initial expenditure will be recovered in a fair amount of time, with a Payback Period (PBP) of 3.58 years. Furthermore, a profitable investment is suggested by the Profitability Index (PI) of 1.26, which is larger than 1. All of these indicators contribute to the project's financial sustainability. The high IRR of 26.83%, which is far more than the minimum required return, suggests an extremely profitable enterprise.

The Figure 4 below summarises the projected revenue of Al-Bahjah's proposed factory from 2026 to 2029.

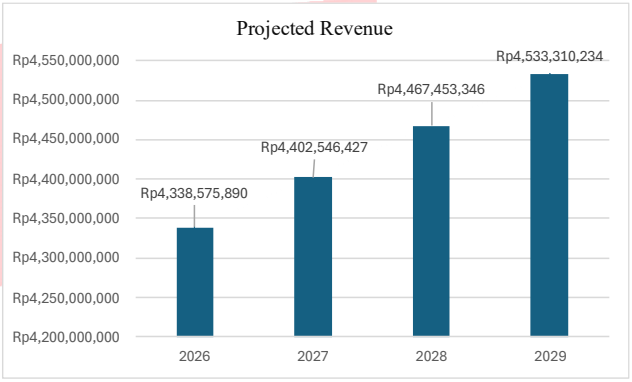

Figure 4. Al-Bahjah's Factory Projected Revenue

The Al-Bahjah's proposed convection factory is expected to make Rp4,338,575,890 in 2026 and Rp4,533,310,234 in 2029, which is a 4.49% increase over the previous three years.

D. Sensitivity and Risk Analysis

A decrease in demand (4.8% tolerance) and an increase in labor cost (8.4% tolerance) are risks that the convection factory must monitor. Besides that, a drop in product selling price (1.1% tolerance) and a rise in raw material cost (1.3% tolerance) have the greatest effects on the project's financial feasibility. The MARR was changed to 24.55% after a risk analysis that took operational and market concerns into account was completed. With an adjusted net present value of Rp27,223,923, the project is still feasible even in these more challenging conditions.

V. CONCLUSIONS

The establishment of an internal convection factory is a feasible, sensible and financially advantageous move for Pondok Pesantren Al-Bahjah, according to the study's findings. The initiative offers a long-term, sustainable solution that improves institutional autonomy and quality control while directly addressing the crucial operational problem of inconsistent, unreliable supplies.

The key findings are:

1. Market Feasibility: To ensure year-round production and profitability, there is a substantial external market for Muslim clothing in addition to a continuous internal demand for uniforms.

2. Technical Feasibility: The proposed factory layout, workers, equipment, and location are all technically feasible and adequate to reach production goals.
3. Financial Feasibility: The project is an appealing investment due to its rapid payback period, high NPV and IRR, and excellent financial returns.
4. Resilience: The sensitivity and risk analysis verify that the project is still feasible even after taking operational and market risk factors into consideration.

In light of these thorough conclusions, it is suggested that Al-Bahjah's management proceed with the investment. In addition to providing an additional stream of revenue and resolving a critical internal issue, this project could also serve as a template for other educational institutions looking to increase their operational independence.

BIBLIOGRAPHY

[1] L. Shen, V. W. Y. Tam, L. Tam, & Y. Ji, "Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice," Journal of Cleaner Production, vol. 18, no. 3, pp. 254–259, 2010.

[2] P. Kotler, K. L. Keller, & A. Chernev, Marketing Management, 16th Ed., Pearson Education, 2022.

[3] H. Winarno, Analisa Aspek Teknis: Suatu Pendekatan Dalam Menilai Kelayakan Proyek, 2008.

[4] Kasmir & Jakfar, Studi kelayakan bisnis: Edisi Revisi, Prenada Media, 2015.

[5] R. A. Brealey, S. C. Myers, F. Allen, & A. Edmans, ISE Principles of Corporate Finance, 14th Ed., McGraw-Hill Education, 2022.

[6] I. R. Hendrayana, E. Chumaidiyah, & B. Purwanggono, "Analisis kelayakan pendirian toko offline dan pabrik konveksi Byadimaprani di Kota Tasikmalaya," eProceedings of Engineering, vol. 4, no. 2, 2017.