THE DYNAMICS OF OPERATIONS MANAGEMENT IN THE PRESTRESSED SPUN CONCRETE POLES INDUSTRY: A CASE STUDY OF ZENN HRB SDN. BHD.

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A Thesis Submitted to Asia e University in
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ABSTRACT

This study examines the operational challenges and determinants affecting ZENN HRB Sdn. Bhd. (ZHSB), a key player in Malaysia's Prestressed Spun Concrete Poles (PSCP) manufacturing industry. As infrastructure development demands grow, the PSCP sector faces increasing pressure to maintain quality, efficiency, and competitiveness. Despite its importance in supplying poles for electricity distribution, telecommunications, and street lighting, ZHSB encounters multiple obstacles including processing inefficiencies, market competition, skilled labor shortages, staff recruitment issues, and financial constraints. This research aims to identify and analyze these operational barriers to support industry advancement. Using a qualitative approach, data were collected through in-depth interviews with eight purposively sampled stakeholders, such as senior factory management, factory operators, government officials, competitors, and customers. Semi-structured and unstructured questionnaires guided the interviews, while mnemonic note-taking and coding facilitated data organization. The thematic framework method was employed to categorize and interpret data into significant themes. Findings indicate that service quality, shortage of skilled workers, environmental regulations, supply chain complexities, cost control, and asset management are critical factors influencing ZHSB's manufacturing operations. These elements interact to shape operational effectiveness and overall productivity. The study highlights the dynamic nature of the manufacturing environment and the need for adaptive management practices to overcome these challenges. This research provides a comprehensive understanding of the multifaceted obstacles facing ZHSB and contributes theoretical and practical insights relevant to the PSCP industry. The study recommends strategic investment in workforce development, enhanced supply chain integration, and environmental compliance as essential measures for improving operational resilience. It also suggests leveraging technology and process innovation to optimize production efficiency. This study also advances knowledge in manufacturing operation management within the Malaysian PSCP sector, offering valuable guidance for stakeholders seeking sustainable growth. Future research could explore quantitative analyses of these determinants, comparative studies across different manufacturers, and the impact of emerging technologies like automation in concrete pole production.

Keywords: Digital spun concrete poles, ZHSB, manufacturing operation management

APPROVAL

This is to certify that this thesis conforms to acceptable standards of scholarly presentation and is fully adequate, in quality and scope, for the fulfilment of the requirements for the Doctor of Business Administration.

The student has been supervised by: **Assoc. Prof. Dr. Ahmad Sabri Yusuff**

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This thesis was submitted to Asia e University and is accepted as fulfilment of the requirements for the Doctor of Business Administration.

Assoc. Prof. Dr. Khursiah Abd Aziz
Asia e University
Chairman, Examination Committee
[8 September 2025]

DECLARATION

I hereby declare that the thesis submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy is my own work and that all contributions from any other persons or sources are properly and duly cited. I further declare that the material has not been submitted either in whole or in part, for a degree at this or any other university. In making this declaration, I understand and acknowledge any breaches in this declaration constitute academic misconduct, which may result in my expulsion from the programme and/or exclusion from the award of the degree.

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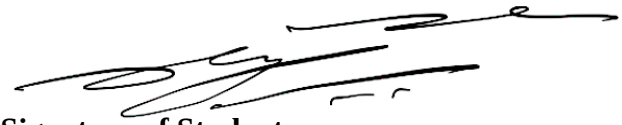

Signature of Student: **Date**: 8 September 2025

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The journey to achieve a Doctor of Business Administration (DBA) has proven to be quite challenging. This is particularly true for me, given my role as the Chairman of ZHSB, which requires me to effectively balance my professional duties with my academic pursuits. I chose to embrace this challenge because I firmly believe in the importance of lifelong learning. It is essential to engage in a continuous cycle of learning, unlearning, and relearning to attain greater levels of personal and professional success.

As we recognize, the landscape of knowledge and practice is ever-evolving, necessitating that individuals stay updated with emerging trends and adapt to changing environments in order to maintain a competitive edge. I am grateful to have successfully navigated this engaging process and am nearing the completion of my thesis. This achievement would not have been possible without the unwavering support of my family, friends, my supervisor, and the dedicated academic team at AeU, who have continually provided me with encouragement and moral support.

In conclusion, I wish to extend my heartfelt gratitude to those who have contributed to making my journey a rewarding experience, including my late parents, Hj Din @ Mohamed Din Bin Hj Ahmad and Hjh Aminah Binti Omar, my wife, Norzana Binti Zulkifly, my children, Tun Aqilah Binti Hang Tuah, Tun Athirah Binti Hang Tuah, Tun Akmal Bin Hang Tuah and Tun Afiq Bin Hang Tuah, my brother, Roslan Bin Mohd Din, my supervisor, Assoc Professor Dr. Ahmad Sabri Bin Yusuff, and everyone who has supported me, either directly or indirectly, on my path to completing this DBA program. May Allah bless them and guide all of us towards a fulfilling life in this world and the hereafter.

Aamin Ya Rabb

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

AI	Artificial Intelligence
CAGR	The Compound Annual Growth
IMR	Independent Market Research
IoT	Internet of Things
MARC	Malaysian Rating Corporation Berhad
MyCC	Malaysian Competition Commission
OM	Operation Management
PCI	Prestressed Concrete Institute
PSCP	Prestressed Spun Concrete Pole
TNB	Tenaga Nasional Berhad
US	United States of America
USD	United States Dollar
ZHSB	Zenn HRB Sdn. Bhd.

CHAPTER 1

INTRODUCTION

1.0 Background of the Studies

The economic downturn in major regions, lack of skilled workforce, and the lack of training are restraining the market growth at the global level. The number of construction projects set to go underway in emerging economies is likely to create beneficial growth opportunities for the prestressed spun concrete poles industry.

Lack of awareness regarding the precast concrete method between end-users and volatility in transportation charges can create an unpredictable business environment are the major challenges for market growth in the near future (MMR, Maximise Market Research, 2022).

The application of prestressed spun concrete poles in infrastructure projects, such as bridges, flyovers, and power transmission systems, offers advantages such as exceptional strength, durability, and resistance to various environmental conditions.

The industry must focus on offering cost-effective items and manufacturing locally to minimize operational costs. The spinning process used in the production of prestressed spun concrete poles results in poles with the highest density and strength to weight ratio of any concrete available, making them more durable.

This issue is based on the analysis of the global prestressed concrete market, which was valued at USD 130.01 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 6% to reach USD 195.50 billion by 2029 (MMR,2023). The market is driven by the increase in population, rapid growth in infrastructure investment, and industrialization. An increase in concerns toward work-zone safety and the necessity for lower environmental impacts and requirements for

reduced construction time and cost are impelling the market growth in the coming years.

Key Issues in Operation Management of Prestressed Spun Concrete Poles Manufacturers Globally which are a significant challenge is the lack of skilled labor and insufficient training in the specialized manufacturing processes required for prestressed spun concrete poles. This shortage affects quality control, production efficiency, and safety.

Manufacturing prestressed spun concrete poles involves complex processes such as centrifugal casting and prestressing wires under tension. Maintaining consistent quality is difficult due to the need for precise control of concrete mix, curing, prestressing tension, and spinning speed. Defects like cracks or insufficient concrete cover can lead to corrosion and premature failure.

Handling, transportation, and erection induce stresses that must be anticipated and managed to avoid damage to poles, which requires careful design and operational planning. The manufacturing process is energy-intensive, involving raw material hauling and steam curing, which raises environmental concerns and operational costs. Sustainability pressures are increasing the need for eco-friendly materials and processes.

Economic downturns in major regions affect construction activity and demand for prestressed spun concrete poles, leading to fluctuating order volumes and operational uncertainty.

Volatility in transportation costs and logistics challenges, especially for long and heavy poles, create unpredictable operational expenses and supply chain disruptions.

There is often a lack of awareness or acceptance of precast and prestressed spun concrete poles among end-users and contractors, especially in emerging markets. This limits market growth and requires manufacturers to invest in education and marketing.

Traditional construction methods, such as cast in-situ concrete or ion poles, remain preferred in some regions due to familiarity, despite the advantages of prestressed spun concrete poles.

Prestressed spun concrete poles must be designed to withstand complex loading conditions, including bending moments in opposite directions, axial loads, and stresses from handling and installation. Ensuring uniform prestressing and avoiding cracking under these conditions is a technical challenge. For very long poles, transportation difficulties have led to the development of segmental poles that require on-site assembly, adding complexity to manufacturing and erection operations.

Although Prestressed Spun Concrete Poles are designed to resist corrosion better than normal reinforced concrete poles, improper design, poor concrete quality, or damage during handling can allow water ingress, leading to steel corrosion and eventual failure over years (MMR, 2023).

One of the most significant benefits of business is the ability to bridge the gap between theoretical learning and practical application. Educational partnerships allow students to apply classroom knowledge directly to real-world business challenges, deepening their understanding and enhancing their problem-solving skills. This hands-on experience not only improves learning outcomes but also ensures that graduates are better prepared for the workforce, equipped with job-ready skills and practical insights

Previous study has been done globally and some findings were established as table below:

1.0.1 Previous Study on Prestressed Spun Concrete Poles Globally

Summarizes key aspects of global research on prestressed spun concrete poles

Here is a table summarizing key global research articles on Prestressed Spun Concrete Poles, including authors, sample details, titles, sources, and main findings based on the search results.

Table 1.1: Summarizes Key Aspects of Global Research on Prestressed Spun Concrete Poles

Authors	Sample	Title	Source/Publication	Key Findings
Thomas E. Rodgers, Jr.	Review of multiple studies	Prestressed Spun Concrete Poles: State-of-the-Art (1984)	PCI Journal, Vol. 29, No. 5, 1984	Comprehensive review of design, manufacture, testing, and use of Prestressed Spun Concrete Poles worldwide; emphasizes advantages of centrifugally spun precast poles and their fatigue resistance.
Unknown (PCI Committee)	Lab test on reinforced vs prestressed poles	Prestressed Spun Concrete Poles - State-of-the-Art (1984)	PCI.org (1984)	Prestressed poles withstand 500,000 load cycles vs few thousand for normal reinforced

				poles, demonstrating superior fatigue performance.
Ahmed M Ibrahim, Ashraf A El Damatty	Not specified	Dynamic behaviour of prestressed concrete transmission poles under synoptic wind loading (2022)	Shock and Vibration Journal, 17(4-5), 551-561	Studied dynamic response of poles under wind loading, providing insights into structural behaviour and resilience.
Xinmei Li et al.	Prestressed reinforced concrete poles	Structural Design of Prestressed Reinforcement for Reinforced Concrete Electric Poles	Atlantis Press (2025)	Developed anti-cracking prestressed reinforcement technology to repair and enhance axial load capacity and flexural strength of poles, extending lifespan.
Authors from Trans Tech Publications	3 samples, 30 years in service	Experimental Study on Mechanical Behaviour of	Advanced Materials Research, Vols. 368-373 (2011)	Bending tests revealed failure modes similar to “rare-reinforced beams”; average safety surplus coefficient of 1.2 before collapse.

		Serving Prestressed Spun Concrete Poles (2011)		
Fouad H. Fouad, D Sherman, Rolf J. Werner	Review article	Prestressed Spun Concrete Poles—Past, Present, and Future (1992)	Concrete International, Vol. 14, pp. 25-29 (1992)	Discussed advantages of Prestressed Spun Concrete Poles, such as elasticity, corrosion resistance, and durability; historical overview provided.
Authors of finite element study	Numerical modelling	Finite element modelling of prestressed concrete poles under high load	ScienceDirect (2017)	First study assessing behaviour of prestressed poles under high load using finite element analysis, aiding design improvements.
Thomas E. Rodgers, Jr.	Review of multiple studies	Prestressed Spun Concrete Poles: State-of-the-Art (1984)	PCI Journal, Vol. 29, No. 5, 1984	Comprehensive review of design, manufacture, testing, and use of Prestressed Spun Concrete Poles worldwide; emphasizes advantages of centrifugally spun precast poles and their fatigue resistance.

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