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RESEARCH ARTICLE **Open Access**

A CRITICAL ANALYSIS OF THE HVAC BUSINESS MODEL TO DETERMINE ITS SUCCESS CRITERIA

Muhammad Awais Javed
School of Business, International American University, Main Campus, Los Angeles, 90010, CA, USA

Abstract
Air conditioning sales in Pakistan have scarcely risen in the recent decade. Air conditioning firms would face stiff competition in this stagnating industry. Some organizations realize that combining goods and services to meet consumer requirements and boost efficiency may boost profits. This Sovietization business model will shift distributors from product-centered to service-centered. Sovietization is not new in Pakistan's air conditioning sector, but it is not widely applied and some operations fail. Pakistan has limited ventilation and air conditioning business model studies. Successful Sovietization deployment requires understanding its components and their effects. This article examines the important success aspects of ventilation and air conditioning Sovietization in Pakistan and how they benefit stakeholders. The author will identify candidate success criteria through literature studies, expert interviews, and surveys. The DEMATEL technique ranks essential success elements. This research will improve knowledge of the Sovietization model in Pakistan and foster innovation.

Keywords HVAC business, profitability, Sovietization deployment, DEMATEL technique, Pakistan.

INTRODUCTION

In the current fiercely competitive air conditioning industry, where both demand and market size have remained stable, enterprises are facing difficulties in sustaining their market position. Annually, the domestic air conditioning sector in Pakistan saw a growth rate of around 1% (Ali et al., 2019). There is a significant discrepancy between this rise and Pakistan's yearly GDP growth rate, which stands at about 5%. The daily air conditioning intake need is calculated using the Cooling Degree Days (CDD) method, which also takes into account the population density of the country as a correlation. An intensely competitive market will emerge as the number of distributors in the industry increases while the rate of growth in inquiries remains sluggish. Price competition amongst market sector rivals indicates an established market. Distributors will compete to offer a more valuable product for customers by raising or lowering prices, which reduces corporate profit (Narayanan & Raman, 2004). To keep ahead of the competition and satisfy customer demand, businesses are always inventing. Offering a service solution is one of these strategies; it increases profit, cash flow, and customer differentiation. Rolls-Royce Aerospace provides hourly power through overhaul, repair, and maintenance (Walker, 2013). The reasonably priced Xerox Managed

Print service takes care of all print consumables, repairs, and maintenance, which also contributes to less waste. The companies might discover new market possibilities by combining products and services to better serve their client. A handful HVAC companies in Pakistan have used Business in the last 10 years. Air conditioning companies that just sold products started bundling consultation, design, installation, maintenance, temperature set-point, and spare parts management into an agreement known as a Cold Contract. Pakistani HVAC contractors are hesitant to adopt Business. Additionally, there are specific projects that face challenges in generating the expected revenue (Pan et al., 2024). One common challenge that often leads to confusion is determining the priority of tasks when implementing Business. Very few studies continue to address this enigma as most focus on the efficacy and performance of HVAC products and on a fresh business approach for the air conditioning industry. Many studies have examined the financial performance, supplier relationships, and factors related to HVAC Business. However, there is a lack of information regarding the achievement of successful HVAC Business. Different national origins and business models affect industry-specific features (Gerasymenko et al., 2015). Given this environment, the paper examines HVAC Business in Pakistan to achieve the following goals: To determine the important success factors and their interdependencies to help firms accomplish Business goals. To efficiently allocate resources, organizations must priorities Critical Success Factors (CSFs) by significance.

LITERATURE REVIEW

According to Auguste et al. (2006), businesses are making available a wide variety of services in addition to their products in order to satisfy the requirements of their customers. Furthermore, the provision of services results in an increase in income. Experts believe that consumers who purchase long-lasting products will remain loyal to a business that provides them with satisfactory service. When a firm moves from a product-centric strategy to a service-centric approach, the focus switches from the value of the product assets to the customer's understanding of the advantages of the product. The Company may place a greater emphasis on the advantages of its products and services than on the valuations of its assets (Almeida et al., 2022). All of the companies that are involved in the ventilation and air conditioning (HVAC) industry are responsible for the development, installation, maintenance, and purchasing of air conditioning systems. These companies include distributors, consultants, contractors, and retailers. According to Oe and Yamaoka (2023), the following factors are important in determining the success of a company: leadership, business model, capacity, personnel, technology, culture, and value co-generation all play a part in the HVAC industry. According to Deng et al. (2021), the hierarchical regression and logistic regression are the two most common types of research methodology utilized in the field of air conditioning maintenance study.

RESEARCH METHODOLOGY

The study has employed several research methods, and the Analytic Hierarchy Process (AHP), a case study, and a longitudinal econometric methodology. Due to variations among sectors and businesses, there is no universally applicable method for establishing the specific characteristics that are considered crucial for success. The study has presented systematic approaches have been utilized as: This approach consists of five phases: (1) Choose the elements of success; (2) Evaluate them; (3) Present the kind and connection of standards; (4) Determine the importance of standards; and (5) Validate crucial success factors with experts. Figure 1 illustrates the relationship between the study variables in the research examination.

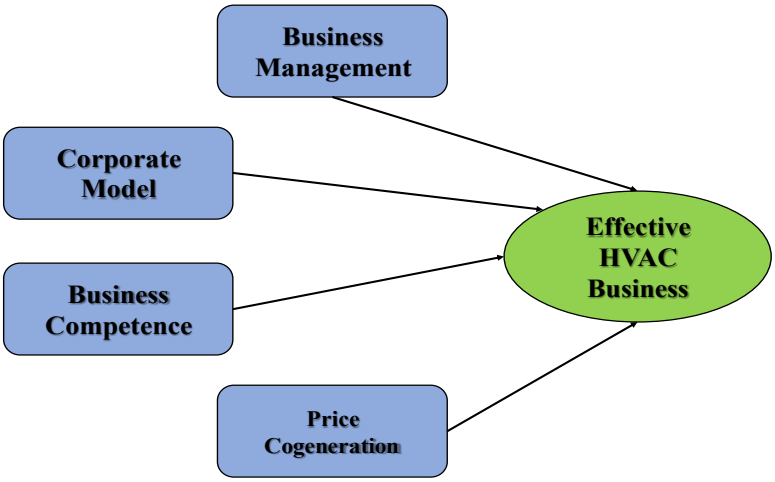

Figure 1. Conceptual framework of the variables

The following is an outline of the research methodology: To ascertain the components of success, familiarize yourself with pertinent research published in reputable publications. The variables will be established by a comprehensive analysis of existing research papers. The process of air conditioning Business has been previously determined by the analysis of seven factors and eleven criteria. Furthermore, to locate SSFs, it is advisable to conduct interviews with HVAC Business specialists. Utilize the DEMATEL approach to identify the variables that constitute the Selected Success Factors and analyze their relationship with the criteria. To conduct a comparative analysis of the data, employ the DEMATEL weighting approach as suggested (Kobryń, 2017).

3.1 Expert interviews to consolidate selected success factors

The literature evaluation found little HVAC Business research in Pakistan. This expert interview seeks to identify Pakistan's HVAC industries' Business success aspects. Two directors and three project managers from HVAC contractors participated in the pilot research's final expert interviews. People are asked to rate the present situation using the HHVAC service Critical Success Factor (Kobryń, 2017). The study has eliminated extraneous information throughout this process. The interview revealed Pakistan's HVAC privatization's Selected Success Factors.

3.2 DEMATEL-Based CSF Attribute-Weight Correlation

DEMATEL prioritizes variables by correlation and effect. This method will demonstrate the system's variable correlation dominance and cause and effect using matrices and graphs.

3.2.1 Build a Survey First

This study examined the elements and subfactors that impact air conditioning Business success using a closed-ended questionnaire on a Likert scale from 0 to 4. The scale goes from "no impact (0)" to "very high impact (4)."

3.2.2 Create Direct Correlation Matrix

Surveys and expert opinions feed the Direct Correlation Matrix. Normalize the direct correlation matrix (x). It has been standardizing the Direct Correlation matrix by using Equation 1 to 3

$$M = f.R \qquad (1)$$

$$M = \frac{1}{\max\limits_{0 \le x \le 1} \sum_{j=1}^{n} a_{ij}} \qquad (2)$$

$$S = Y\,(I - Y)^{-1} \qquad (3)$$

Whereas Composed Cause and Effect is designed as follows;

$$D = \left|\sum_{i=1}^{m} h_{ij}\right| \text{ dan } R = \left|\sum_{j=1}^{m} h_{ij}\right|, \text{ i, j = 1,2, ..., n}$$

The correlation between criterion is indicated in Column D+R. Meanwhile, Column DR shows Criteria's influencer status. When a D-R value is positive, the criterion affects other criteria, and when it is negative, other criteria affect the criteria. Based on the table's results, a cause-and-effect diagram with D+R as the X-axis and D-R as the Y-axis will be constructed.

3.2.3 Weight Determination

The following formula has been used with DEMATEL to calculate criteria weight (Baykasoğlu et al., 2013). The formula is described as Equation 4 as follows:

$$\varphi = \left((h^{+})_i^2 + (h^{-})_i^2\right)^{1/2} \qquad (4)$$

The equation accommodates both negative and non-negative (D-R) values. The approach decreases the precision of object weight measurements. Calculating the weight of criteria is done by using the average value of D+R and D-R, as these values indicate the relevance and relationship between them (Kobryń, 2017) in Equation 5 as:

$$h_i^{mean} = \frac{1}{2}(h^{+} + h^{-}) \qquad (5)$$

The subsequent equation will be employed to standardize the equation.

$$\boldsymbol{Z_i = \frac{h_i^{mean}}{\sum_{i=1}^{m} h_i^{mean}} + \partial, \text{ with } 0 \le \partial \le \min h_i}$$

4. Results and Discussions

Table 1 represents the JRAIA (2019) show the scenario that the HVAC business systems under review are found in various buildings and residential areas. Included are finished units with heat pump varieties for both cooling and heating. The portable fan coil units used in HVAC systems and hydronic systems are not included. Window-style units, small-sized split units, and multiple systems for residential use are all necessary HVAC systems.

Table 1. Requests for quotations on residential HVAC business

	2018	2019	2020	2021	2022	2023	2020-2023

	y 890	y890	y 890	y 890	y 890	y 890	Growth
Global	83,627	90,706	86,366	88,807	96,603	96,071	4%
Asia	13,379	14,396	13,736	16,927	13,983	16,129	29%
Pakistan	4,273	4,398	4,309	3,309	3,273	3,276	5%

Large and medium-sized split type units, units with remote condensers, single packaged units, and VRF systems are all available on the commercial air conditioning market. Table 2 represents the JRAIA (2019) show the scenario that in Pakistan, unitary air conditioners and heat pumps are also widely used.

Table 2. Market research for businesses to provide commercial HVAC business services

	2018	2019	2020	2021	2022	2023	2020-2023
	y 890	y 890	y 890	y 890	y 890	y 890	Growth
Global	13,927	13,086	14,291	13,297	16,367	16,900	9%
Asia	1,389	1,366	1,627	1,728	1,629	1,696	31%
Pakistan	89	89	89	83	86	83	-8%

Table 3 represents the Pakistan is ranked based on their CDD. The Mazhar group (2022) From 2001 to 2018, the spatiotemporal patterns of three biophysical parameters—albedo, NDVI, and LST—and three energy budget parameters—net radiation, latent heat flow, and sensible heat flux—are examined.

Table 3. Rank a nation according to its CDD

Country	Population (in millions)	Population-weighted annual CDDs	Product of population and CDDs (in billions)	Global share (%)
China	1397	1009	1610	10
Nigeria	181	3639	629	6
Pakistan	189	2706	589	5
Philippines	103	2766	273	2
Bangladesh	161	3542	636	5
Brazil	306	2908	578	3
United States	297	867	377	7
India	1452	3872	2836	38
Vietnam	96	3777	360	2
Indonesia	278	2848	759	6

The daily air conditioning intake need is determined using the CDD technique, which also uses the population density of the nation as a correlation (Mushore et al., 2017). A highly competitive market will be created when the number of distributors in the market rises and the volume of inquiries grows more slowly. Table 4 shows the revised success indicators that are based on expert interviews with Pakistani air conditioning industry professionals and represent the current situation of the sector.

Table 4. Critical achievement features adjustable from proficient conference

Variables	Code	Criteria
Business Management	BM1	Advancement
	BM2	Eloquent Revelation
	BM3	Inspirational and contribution
Corporate Model	CM1	Monetary Preparation
	CM2	Stretched Period Strategy
	CM3	Development Assortment
	CM4	Consequence Founded Agreement
Business Competence	BC1	Operative Controller
	BC2	Excellence of Provision
Price Cogeneration	PC1	Association Excellence
	PC2	Sympathetic Purchaser

Research indicates that insufficient information and support from management pose significant barriers to the implementation of energy efficiency programs. The inadequate adoption of energy-efficient technology can be attributed to the absence of effective government policies and a dearth of implementation techniques. However, responders are largely focused on cost savings through the reduction of energy use. The main motivations for implementing energy-efficient methods include enhancing working conditions, reducing expenses, and attaining sustainable economic benefits. Several firms have adopted environmentally friendly practices by transitioning to renewable energy sources and implementing state-of-the-art technology.

4.1 Effective HHVAC Business

Table 5 provides an indication of the first direct relationship matrix that is collected from five specialists. The DEMATEL technique is employed to quantify the impact of each criterion on a system and to graphically depict the complex network of causal relationships between criteria. By using these influence level values as the basis for the normalization super matrix for the creation of ANP weights, the study can determine the relative importance.

Table 5. Represents the matrix of direct relationships

	BM1	BM2	BM3	CM1	CM2	CM3	CM4	BC1	BC2	PC1	PC2	Total
BM1		3	3.6	3	3	3.6	3	3.6	1.8	0.6	3	27.6
BM2	3		3.6	1.3	3	1.6	3.8	1.6	3.6	1.6	1.3	29.8
BM3	3.3	3.3		0.8	3.6	3.6	3.6	3.6	3.6	3.3	1.6	27.3
CM1	0.3	0	0.3		6	3.3	3.3	1.8	3.6	3	1	30
CM2	0.6	0.3	0.6	3		3.6	3.8	3	3.3	3.6	3.3	29.3
CM3	0.3	0	0.3	3.6	3.8		3	3.6	3.3	3.3	3.6	29
CM4	0.6	0.3	0	3.6	6	3.8		3.8	3.6	3.6	3.6	27.6
BC1	0.3	0	0.3	0.6	3	1.8	0.6		3.3	1.6	1.6	10.6
BC2	0	0	0	0.3	1.8	3.3	1.6	3.6		3.6	1.6	13.6
PC1	0.6	0.3	0.3	1	3	3.3	3.3	3.8	3.8		3	16.8

PC2	1.6	0.6	0.3	1.6	3.6	3.3	3.6	3	3.6	3.8		27.6

Table 6 represents the total relation matrix. The DEMATEL approach, which aids in identifying the interdependencies among all elements, is used to assess these factors. Furthermore, it is useful for classifying the element under review as either a cause or an effect. There is a full explanation of the significance of the criteria and the interactions between these factors.

Table 6. Representation of total relational matrix results

	BM1	**BM2**	**BM3**	**CM1**	**CM2**	**CM3**	**CM4**	**BC1**	**BC2**	**PC1**	**PC2**
BM1	0.08	0.11	0.16	0.36	0.69	0.66	0.39	0.63	0.63	0.37	0.39
BM2	0.3	0.03	0.18	0.38	0.67	0.6	0.6	0.39	0.63	0.39	0.27
BM3	0.3	0.13	0.06	0.36	0.63	0.63	0.38	0.63	0.66	0.61	0.27
CM1	0.06	0.03	0.06	0.3	0.66	0.63	0.37	0.36	0.63	0.61	0.39
CM2	0.07	0.03	0.03	0.29	0.27	0.63	0.37	0.61	0.66	0.61	0.27
CM3	0.06	0.03	0.06	0.3	0.66	0.29	0.37	0.63	0.63	0.39	0.36
CM4	0.09	0.06	0.06	0.37	0.36	0.29	0.27	0.66	0.27	0.3	0.63
BC1	0.06	0.01	0.03	0.13	0.36	0.27	0.16	0.16	0.27	0.29	0.18
BC2	0.06	0.01	0.03	0.16	0.38	0.38	0.27	0.39	0.27	0.27	0.27
PC1	0.06	0.03	0.03	0.3	0.36	0.27	0.3	0.36	0.38	0.36	0.29
PC2	0.13	0.06	0.03	0.3	0.3	0.67	0.63	0.63	0.29	0.69	0.39

To take into account the association between the criteria, a threshold is established that is one standard deviation above the mean. Among the most important characteristics are inventive leadership, the ability to explain visions, a leadership style that is both inspiring and interactive, contractual agreements that are outcome-focused, a business model that is built on subscriptions, and good customer relationship management. Long-term planning, project selection, efficient control, service quality, and relationship quality are all components that are included in the sphere of influence of the receiver (Chang et al., 2009). Table 7 represents the criteria connection created using data on criteria importance and relation.

Table 7. DEMATEL analysis evaluates criterion importance and applicability

Measures	**Symbols**	**D**	**R**	**D+R**	**D-R**
Advancement	**BM1**	3.63	1.03	6.66	3.61
Eloquent Revelation	**BM2**	3.36	0.3	6.03	3.06
Inspirational and contribution	**BM3**	3.3	0.67	6.17	3.86
Monetary Preparation	**CM1**	3.07	3.86	3.83	0.36
Stretched Period Strategy	**CM2**	3.27	6.36	7.76	-1.27
Development Assortment	**CM3**	3.18	6.27	7.61	-1.06
Consequence Founded Agreement	**CM4**	3.86	3.73	7.39	0.1
Operative Controller	**BC1**	1.63	6.1	3.73	-3.67
Excellence of Provision	**BC2**	3.07	6.6	6.67	-3.36
Association Excellence	**PC1**	3.39	6.17	6.76	-1.38
Sympathetic Purchaser	**PC2**	3.61	3.66	7.03	0.16

Quadrant I include the essential components as part of its criteria. It is crucial to acknowledge that while subscription models are essential, outcome-based contracts and user understanding are extremely critical. All of these concepts have an impact on other individuals. HVAC business operate as distinct suppliers since Corporate Leadership and its requirements are closely interconnected but relatively less significant (Porter & Kramer, 2002). Receivers are located in quadrant IV due to several factors. The approaches proposed by Kobry (2017) are employed to ascertain the importance of each criterion. Table 8 indicates that outcome-based contracts are considered the most beneficial in both approaches, as it illustrates the elements that are scored differently.

Table 8. Represents the weighting of criteria according to DEMATEL technique

Measures	2016			2023		
	Ø	w	rank	t avg.	w	rank
Advancement	3.36	0.076	9	3.63	0.107	3
Eloquent Revelation	3.03	0.07	10	3.36	0.106	6
Inspirational and contribution	3.06	0.07	11	3.3	0.103	3
Monetary Preparation	3.83	0.083	8	3.27	0.089	6
Stretched Period Strategy	7.87	0.11	3	3.07	0.083	8
Development Assortment	7.72	0.106	3	3.18	0.096	7
Consequence Founded Agreement	7.39	0.106	1	3.86	0.113	1
Operative Controller	6.36	0.087	7	1.63	0.072	11
Excellence of Provision	7.16	0.1	6	3.07	0.061	10
Association Excellence	6.96	0.097	3	3.39	0.076	9
Sympathetic Purchaser	7.03	0.098	6	3.61	0.107	3

HVAC Business is impacted by outcome-based contracts, customer comprehension, leadership considerations, and subscription models. To achieve sustainability performance, it is crucial to focus on three key factors: human capital, technical platforms, and value-based pricing. These sub-enablers play a vital role in ensuring long-term success. Adding value to the service through innovation is a crucial factor for success. It aids managers in service-oriented businesses, especially in developing nations, in making informed decisions regarding BMI and service-dominant logic.

CONCLUSIONS

Disagreements and uncertainties have arisen due to the implementation of the HVAC Business in Pakistan. Conducting research on important success elements are highly advantageous for organizations. Businesses have gained valuable insights into cash distribution for the HVAC company thanks to the findings. These five criteria carry the majority of the weight, accounting for a significant 54% of the total. These principles encompass leadership and the idea of providing service. The most significant type of contract is the outcome-based contract (BM4), which carries a weight of 0.113, the highest possible score. After completing that task, it's important to have a clear understanding of the customer's needs. Both BM4 and VC2 offer valuable assistance and networking opportunities for the business. Our main focus is on understanding customer needs and developing a contract that helps them achieve their goals. Given that CL1, CL2, and CL3 are

essential for corporate leadership, this model is guided by these prerequisites. Throughout the shift, effective leadership plays a crucial role in shaping the business model and fostering strong client relationships.

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