Spectrum of Engineering Sciences
Online ISSN
3007-3138
Print ISSN
3007-312X
SPECTRUM OF ENGINEERING SCIENCES

Exploring Innovation Management Strategies in Pakistan's Manufacturing Industry

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Abstract

This research identifies the emergent factors influencing the management of innovation in manufacturing companies in Pakistan. The study highlights the growing significance of innovation in the manufacturing sector of an emerging economy, where competitive pressures, legal requirements, and the need for technological advancements are pivotal for growth. Limited research on innovation management practices within the Pakistani manufacturing industry underscores the importance of gaining insights into these practices to enhance competitiveness. The primary objective of this research is to explore and evaluate the factors shaping the innovation landscape

in Pakistan's manufacturing sector, focusing on stakeholder engagement and the efficiency of various innovation strategies. A survey was conducted to measure the perceived importance and involvement of industry stakeholders in innovation activities. Factors such as Leadership Commitment, Technological Infrastructure, and Employee Training were assessed to understand the level of organizational support for innovation initiatives. The study employs academic literature, a self-administered survey, and analytical tools including the Relative Importance Index (RII), Analytic Hierarchy Process (AHP), SPSS, and PESTEL analysis to evaluate survey data. These methodologies provide a comprehensive assessment of the factors affecting innovation success. Recommendations emphasize the need for a holistic approach to managing innovation in Pakistan's manufacturing industry. Key suggestions include enhanced management support, resource allocation, and continuous development to strengthen internal capabilities and adapt to external forces. This research offers valuable insights for policymakers and industry stakeholders, advocating for a focus on building competitive advantages and providing targeted support to foster a culture of innovation and ensure the sustainable growth of Pakistan’s manufacturing sector.

Keywords: Pakistani Manufacturing Industry, key Factors, Relative Importance Index (RII), Analytic Hierarchy Process (AHP), PESTEL Analysis

1. Introduction

Innovation management is a key principle that determines the competitiveness of industries in today's world of active technologies and markets (Appio et al., 2021). Across the globe today there are increasing complexities and pressures of competition driving industries to search for better and efficient solutions to undertake their businesses appropriately and sustainably and in this respect the point of call is innovation. Innovation facilitates change, fosters strategic adaptability and capture of opportunities as firms deal with change challenges (Hino, 2024). Particular significance for this study is the fact that manufacturing organizations are under constant pressure to cut costs, increase product quality and optimise processes (Taques et al., 2021).

Manufacturing industry is one of the major drivers of the economy of Pakistan. Employment generation, export development and a strong basis of industrialization and urbanization are the key advantages the sector has brought (Ullah et al., 2022). It extends itself across sectors like textile, automobile, cement, chemical, pharma and engineering goods, etc. These challenging arguably relate to outdated technologies and misallocation of resources, fierce global competition and increased costs of the production inputs (Khan et al., 2022). This competitive environment in the global manufacturing sector has exerted tremendous pressure on Pakistani manufacturers to adopt new technologies, changes in its manufacturing processes and improvement in productivity (Shahzad et al., 2022).

However, despite the need for innovation, the practice of structured innovation management in context of firms operating in Pakistan is still embedded in its nascent stage (Nadeem et al., 2024).

Most organizations do not have proper systems, managerial engagement, and support structures that allow systematic innovation. Therefore, they experience problems in sustaining their competitiveness, within their countries' borders and around the world (Rehman et al., 2021). The problem is not unique to funding new innovations but the ability to cultivate a platform where new ideas can be tried out and the process of innovation can be continually improved (Jones et al., 2021).

Therefore, innovation management is not limited to technology. It includes an R&D, the production of new products, improvement of the existing production processes, cooperation with outside partners, and the systematic utilization of the customer insights as part of the product design process (Elahi et al., 2022). In the context of Pakistani manufacturing firms, the effective and coherent innovation management approach could open a number of rich opportunities to enhance organizational status, generate higher revenues and ensure firm's stability. The research objectives of this study are to establish what is currently being practiced in innovation processes among manufacturing firms in Pakistan and to both cross and establish the specific areas of the firms that prevent them from utilizing innovation as an advantageous tool (MEHTA et al., 2021).

There is significant room for improvement and growth among Pakistan's manufacturing industry regarding efficiency, innovation, and sustainability. However, implementing change in the ideal form that the industrial sector is capable of producing constitutes a major challenge in the management of innovation. Current techniques employed by the Pakistani manufacturers pose some challenges in dealing with technological issues, a factor that greatly limits their

exploitation. To remedy this fundamental problem, it is necessary to approach the study of the techniques of managing innovation without delay. This inquiry will systematically explore the different strategies adopted by the Pakistani enterprises to improve their competitiveness in the emergent industrial environment.

2. Literature Review

Innovation management is the planning, organization and execution of the innovation processes systematically. This consists of all of the activities that an organization undertakes to bring new (or changed) products, services and/or processes to develop fresh options to remain competitive and succeed over time. In addition to product development, managing innovation involves cultivating an organization that is creative, collaborative, and one that learns continuously (Gui et al., 2024).

Indeed, innovation can be divided into stages, such as idea generation, development of the concept, prototyping, testing and commercialization. So effective innovation management makes sure that these stages are handled carefully in coordination or alignment with the organization's strategic goals. Balancing risks and rewards, allocating core elements for effective functions, and the ability of the organization to adapt too many market changes is a part of the management process (Azra, 2023).

Most successful organizations find that their business goals align with a clear innovation strategy. Innovation is driven by leadership commitment in terms of highlights what the culture of innovation must be in the company. Additionally, the fertile environment should be supportive of employees to experiment, take

risks and collaborate with people within and outside a department (Ávila-Robinson et al., 2022).

The manufacturing industry depends on several factors that drive innovation, such as technological development, competition of the market, customers' demands, and regulations. These drivers force firms to innovate, in order to remain competitive, to boost their operational efficiency and satisfy consumer demands (Hariyani et al., 2023).

Pakistan's manufacturing firms are taking up new technologies and more creative strategies to make their operations better. Nevertheless, due to the structural and institutional disadvantages of the industry, innovation is taking a relatively slow pace (Wadho and Chaudhry, 2024).

3. Methodology

The research methodology which forms a basis of this study by exploring the process carried out in Pakistan's manufacturing sector to explore its innovation management strategy. It consists of different techniques, from literature review to data analysis to do a structured process of data collection and examination. The methodology is summarized in Figure 1: Research Methodology Flowchart of which is an outline of a step by step process.

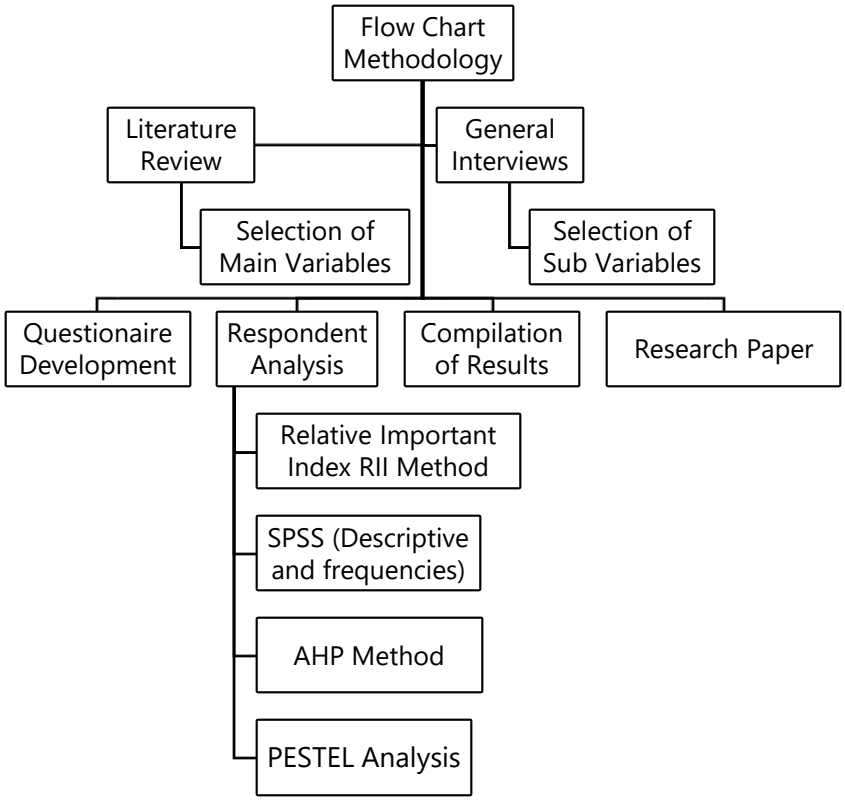

Figure 1: Flowchart of Research Methodology

3.1 Data Collection

From various Internet sources such as online databases and journals; academic papers and studies on innovation management were collected to aid relevant information. To provide the theoretical foundation of the study and to identify the gaps in previous knowledge, a literature review was conducted.

- **Primary Data Collection**: Knowledge from the interviews and from questionnaires filled in by the experts and the management staff in the chosen industries formed the primary data. Some of the areas that were of interest from the completed and analyzed questionnaire included factors that affect the innovation management strategies and effectiveness of the strategies in practice industries.

- **Questionnaire Design**: The overall objective of the questionnaire was to obtain participants' feedback on several factors around innovation such as leadership support, technology support, research and development investment, and partnerships with outside collaborators. With regards to the factors mentioned above, a Likert scale was adopted so as to capture respondents' attitude towards it.
- **Data Processing and Analysis**: Subsequently, the collected data was subjected to data analysis aimed at arriving at useful results and conclusion. To compile the results of the given analysis, the usage of both quantitative and qualitative methods was considered appropriate.

3.2 Analysis Tools

Thus, using manual methods of scanning and categorization was possible to analyze the qualitative data from the response sections. To establish the level of prominence of the above factors in relation to innovation management the Relative Importance Index method and Analytic Hierarchy Process method was applied.

- **Relative Importance Index (RII)**: Relative Importance Index (RII) is a widely used statistical tool in research to determine the relative importance or ranking of various factors based on respondents' opinions or perceptions. It is especially useful when dealing with survey data that uses Likert scales (e.g., 1 to 5, where 1 means "very unimportant" and 5 means "very important").

- **Analytic Hierarchy Process (AHP)**: The Analytic Hierarchy Process (AHP) is a complex decision making tool originated by Thomas L. Saaty. It is a powerful and flexible technique that can assist people and organizations make complex decisions in a more structured manner because those decisions are decomposed in the lexicon into a set of criteria and options. AHP has been applied in different domains that include the commercial domain, the engineering domain, project management domain, and the strategic planning domain. The comprehensive step wise Analytic Hierarchy Process (AHP) for the data analysis was followed.
- **Correlation between RII and AHP:** The Relative Importance Index (RII) and Analytic Hierarchy Process (AHP) are in the same line as the parameters and this confirms the reliability and consistency of your assessment technique. It has first been noted that when one method, either RII or AHP, assigns a higher importance ranking to some factors, the other method also observes the same factors as largely important when compared to the other ones. Such convergence also increases confidence in the results of your work, and the factors prioritized in your study are perceived as significant and recognized in a variety of analytical methods.
- **PESTEL Analysis**: The working environment analysis showed that the factors driving innovation management in the manufacturing industry in

Pakistan are complex and interrelated. Every one of the six elements — Political, Economic, Social, Technological, Environmental, Legal all have their essential contribution to the establishment of innovation strategies.

- **Reliability Test**: To test reliability, the Cronbach alpha reliability test was used to check the level of reliability of data collected from the questionnaires. This test was used to determine the internal consistency and therefore check the reliability and validity of the responses on the survey.

4. Results

4.1. Relative Importance Index (RII)

The following procedure to analyze the Relative Importance Index (RII) for the factors given in the data for analyzing the innovation management in manufacturing industry of Pakistan RII is calculated using the formula:

$$RII = \frac{\sum(W \times N)}{A \times N}$$

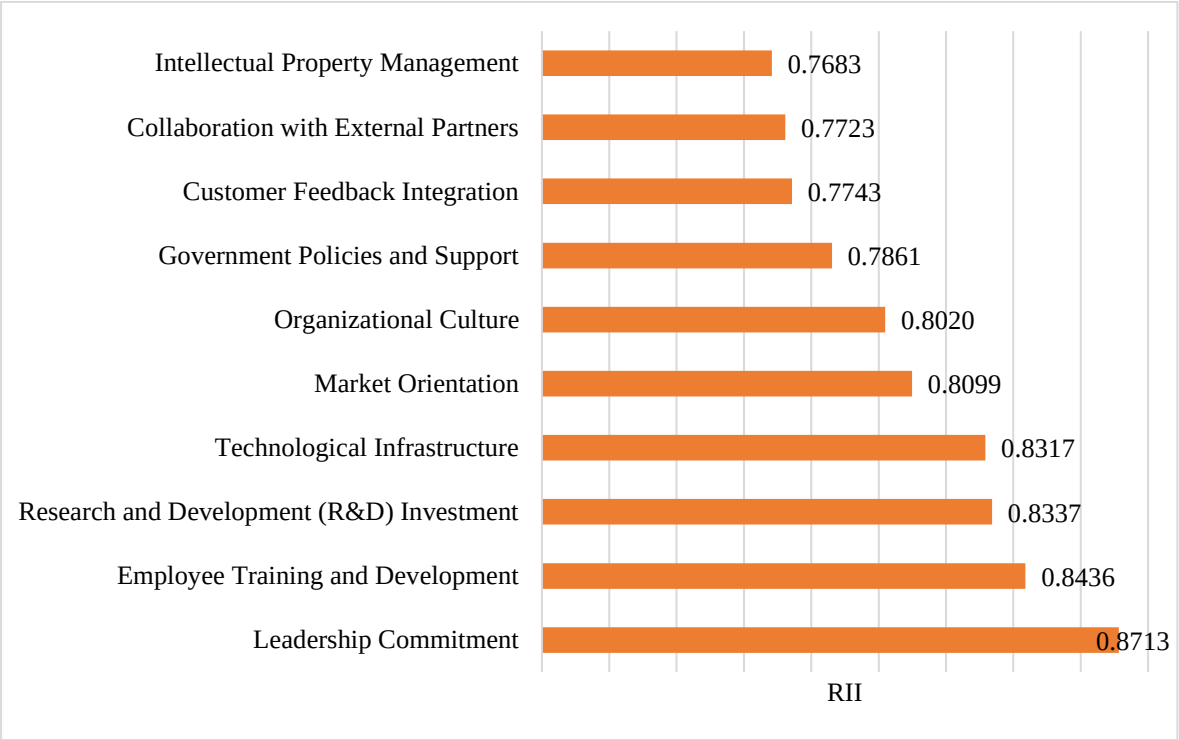

Figure 2: Relative Importance Index of Significance Factors

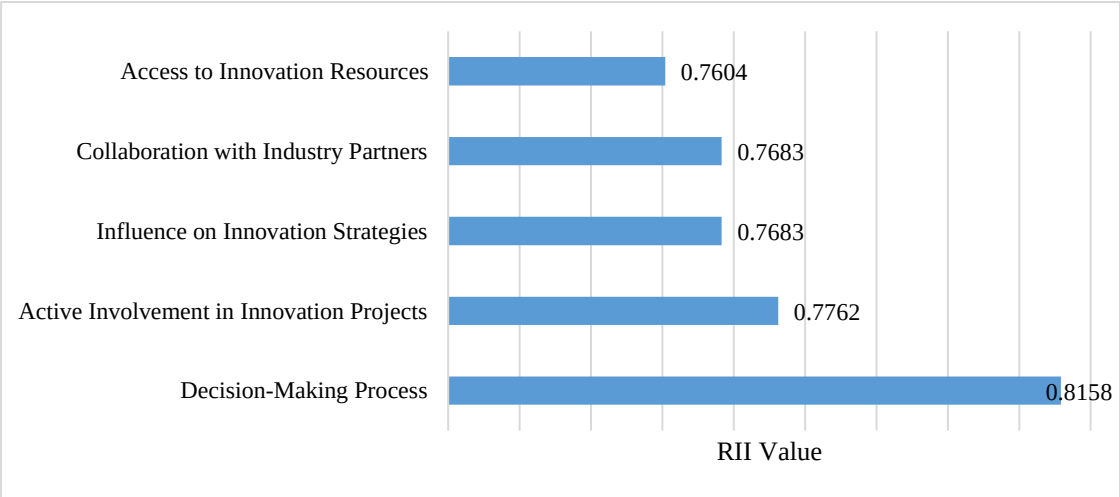

Figure 3: Relative Importance Index of Involvement Factors

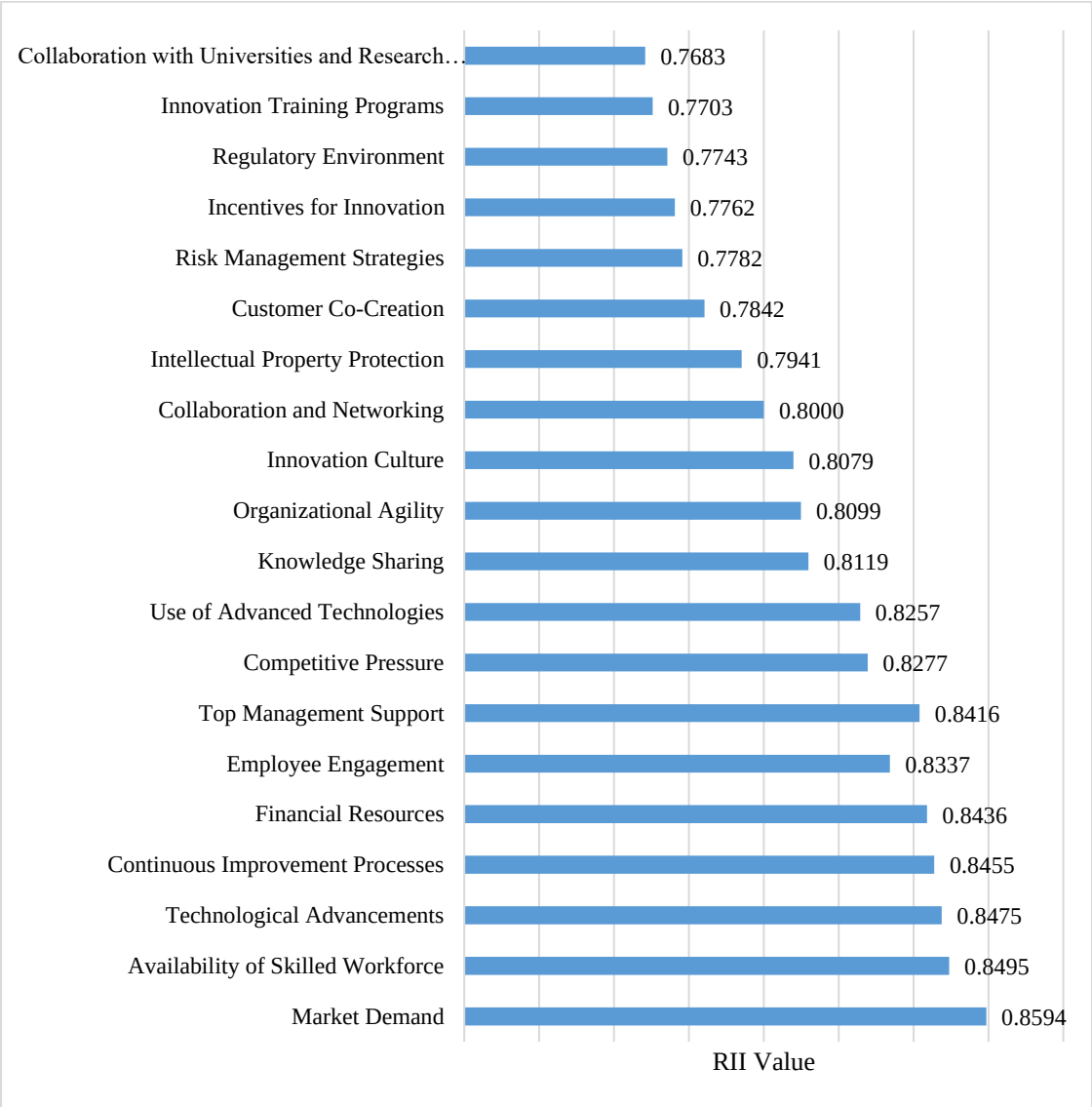

Figure 4: Relative Importance Index of Success Factors

4.2. Analytic Hierarchy Process (AHP)

Pairwise Comparison Matrix:

The first part of AHP is the pairwise comparison matrix. Each cell in this matrix represents the relative importance of one factor compared to another.

Normalization:

- Normalize each column by dividing each element by its column sum to get the normalized pairwise comparison matrix.

Calculate Weight Vector:

- Calculate the average of each row in the normalized matrix to obtain the weight vector representing the relative importance of each criterion.

Eigenvalue and Eigenvector:

- Determine the principal Eigenvector of the pairwise comparison matrix. This Eigenvector represents the decision makers' preference, by providing the priority weights of the criteria.

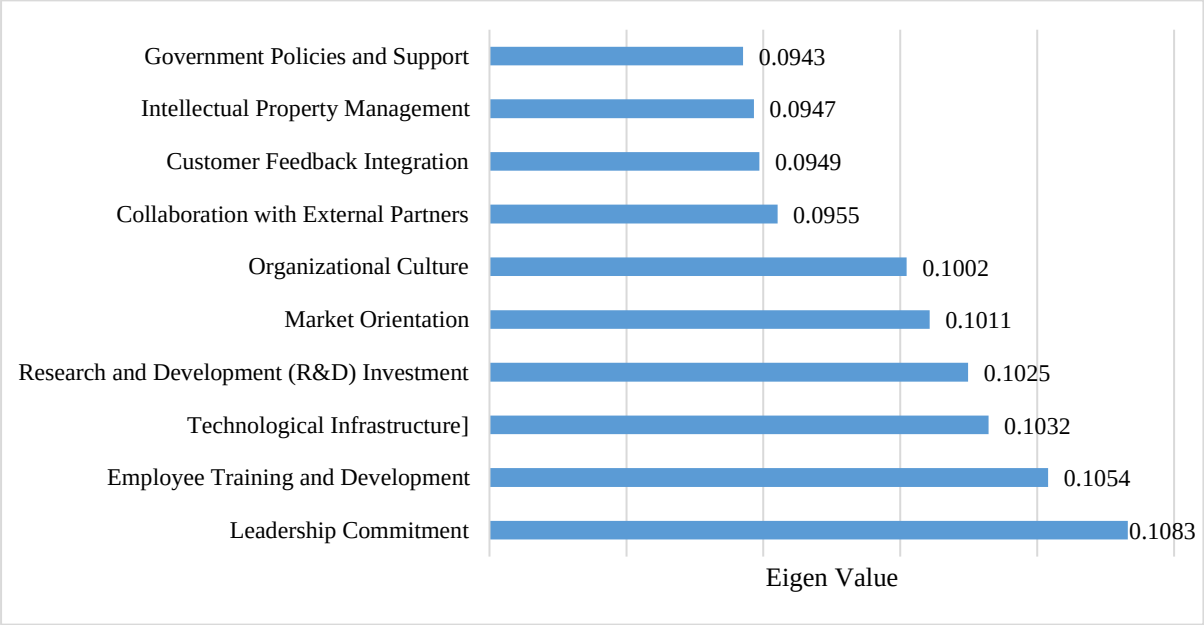

Figure 5: Analytic Hierarchy Process (AHP) of Significance Factors

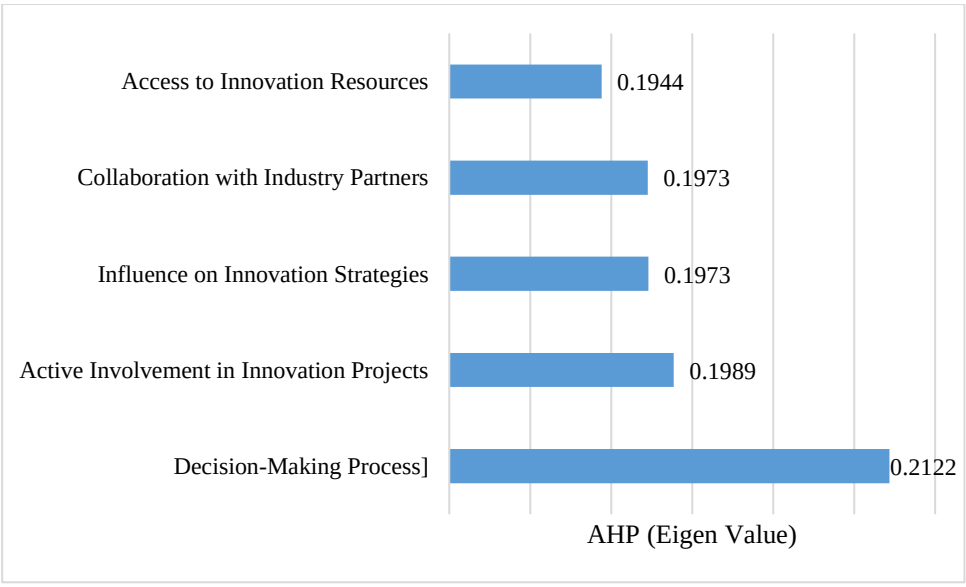

Figure 6: Analytic Hierarchy Process (AHP) of Involvement Factors

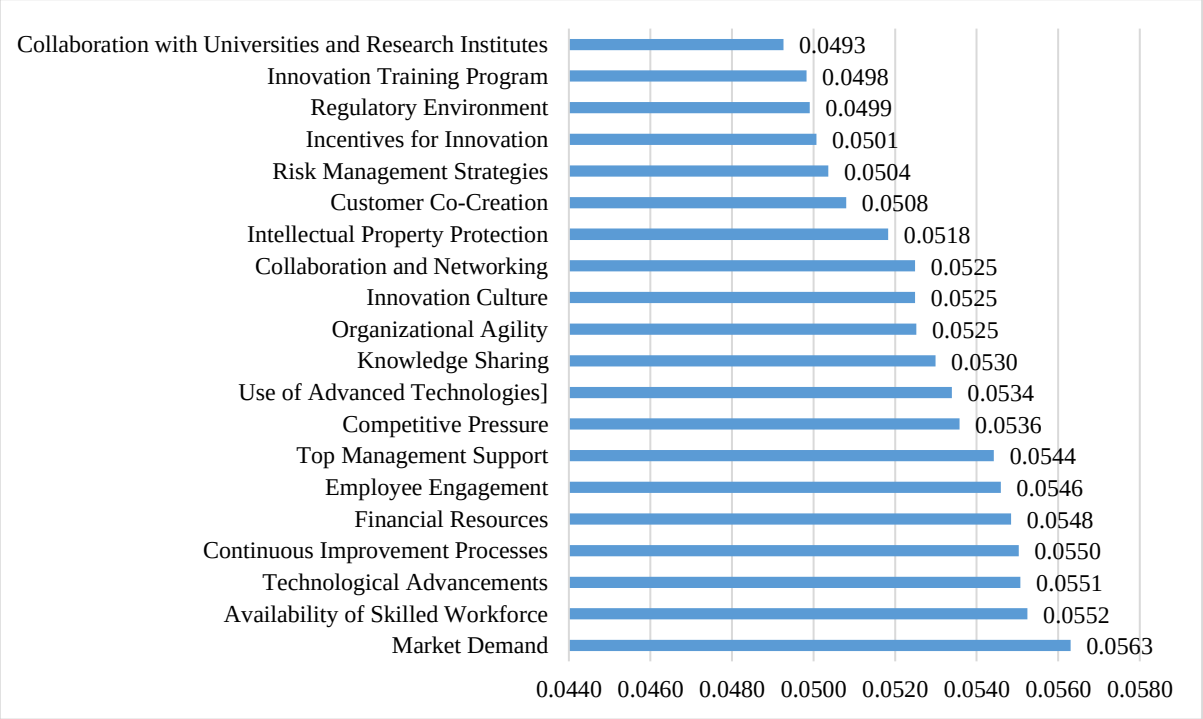

Figure 7: Analytic Hierarchy Process (AHP) of Success Factors

4.3. Correlation between RII and AHP

Hence the agreement of two evaluation methods, the Relative Importance Index (RII) and the Analytic Hierarchy Process (AHP) affirms the reliability of each. That is when the values obtained for the concerned factors are similar in both RII and AHP, it indicates that the factors identified as being of high importance in one approach is also deemed as important in the other. It also reduces the likelihood of error, and confirms that your conclusions will be prevalent in the associated factors, highlighted as the most important in the research.

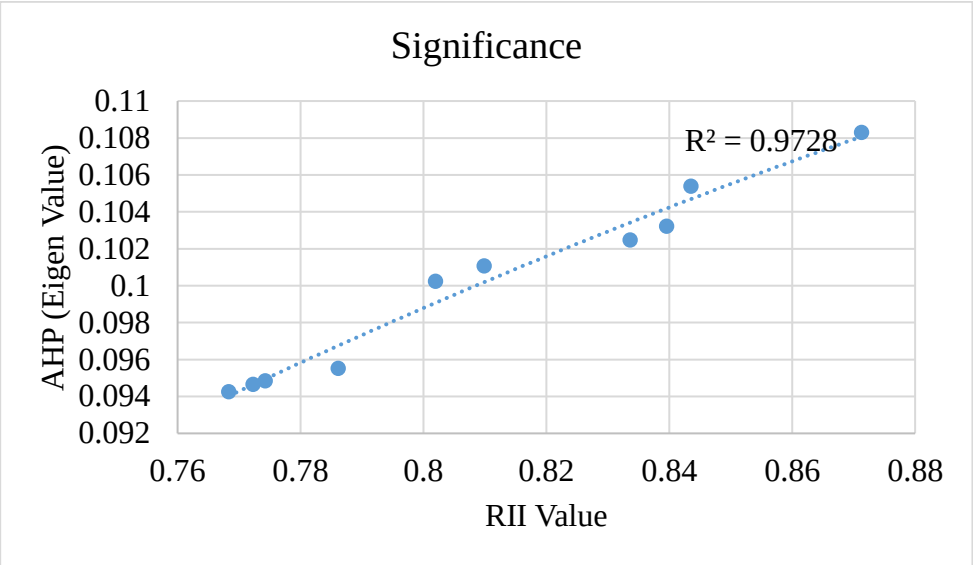

Figure 8: Correlation between RII and AHP Significance Factors

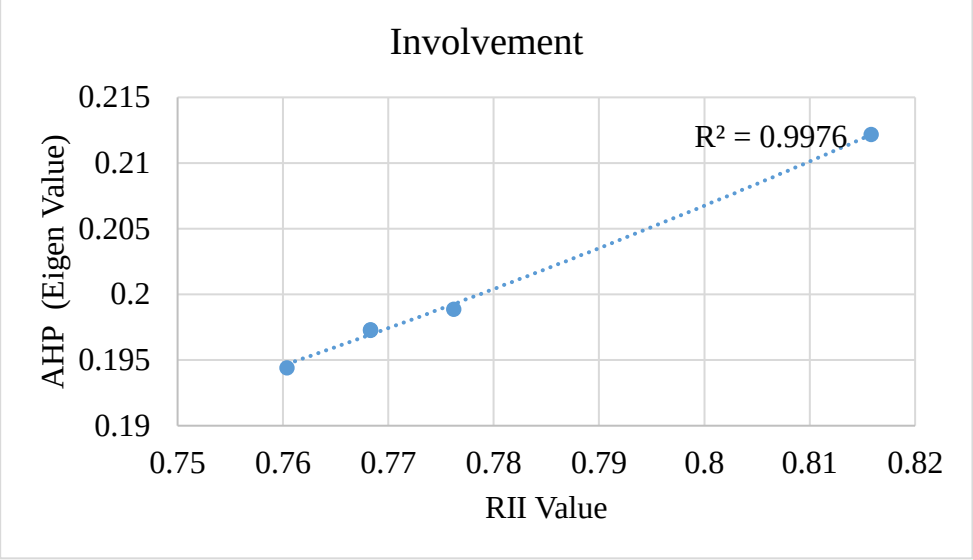

Figure 9: Correlation between RII and AHP Involvement Factors

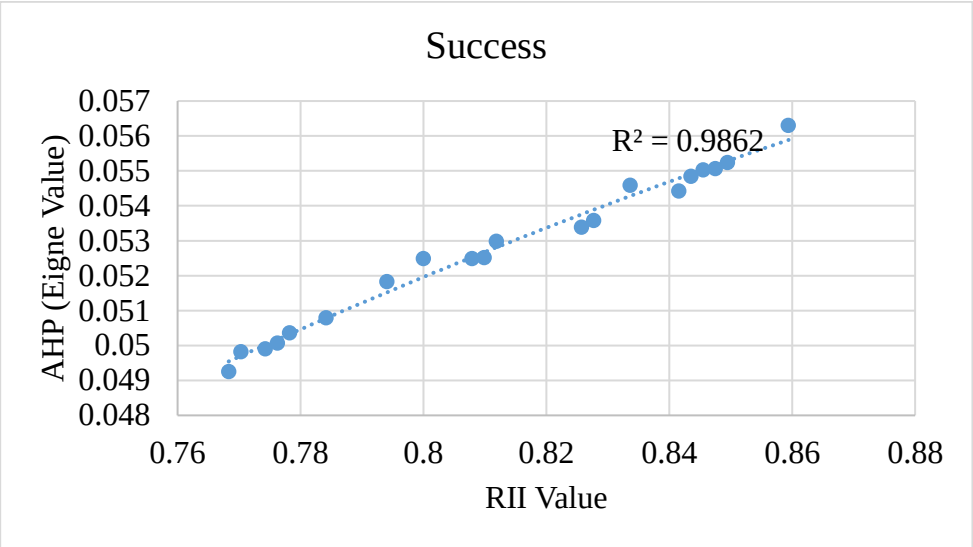

Figure 10: Correlation between RII and AHP Success Factors

4.4. PESTEL Analysis

The PESTEL analysis reveals a multifaceted landscape that influences innovation management in Pakistan's manufacturing industry. Each of the six external factors — Political, Economic, Social, Technological, Environmental, and Legal — plays a pivotal role in shaping innovation strategies.

Table 1: PESTEL Analysis

PESTEL Category	Factors	RII	AHP (Eigen Value)	RII × AHP (Weighted Value)
Political	Government Policies and Support	0.7683	0.094654326	0.0727
Economic	Financial Resources	0.8436	0.05507185	0.0464
	Market Demand	0.8594	0.056305801	0.0484
	Competitive Pressure	0.8277	0.054845073	0.0454
Social	Leadership Commitment	0.8713	0.108310934	0.0944
	Organizational Culture	0.8020	0.101070999	0.0811
	Employee Training and Development	0.8436	0.100234559	0.0846

	Top Management Support	0.8416	0.052489748	0.0441
	Employee Engagement	0.8337	0.052520278	0.0438
	Knowledge Sharing	0.8119	0.052489748	0.0426
	Customer Feedback Integration	0.7743	0.095516955	0.0739
	Customer Co-Creation	0.7842	0.049825012	0.0391
	Collaboration with External Partners	0.7861	0.094853074	0.0745
	Collaboration and Networking	0.8000	0.052989524	0.0424
	Collaboration with Industry Partners	0.7683	0.197300317	0.1515
	Collaboration with Universities and Research Institutes	0.7683	0.055029901	0.0422
Technological	Technological Infrastructure	0.8396	0.10247848	0.0860
	Research and Development (R&D) Investment	0.8337	0.10539795	0.0879
	Technological Advancements	0.8475	0.049908896	0.0423
	Use of Advanced Technologies	0.8257	0.051831642	0.0428
	Innovation Training Programs	0.7703	0.053391014	0.0411
	Access to Innovation Resources	0.7604	0.198866359	0.1512
	Influence on Innovation Strategies	0.7683	0.197253993	0.1514
	Continuous Improvement Processes	0.8455	0.055245085	0.0467

	Active Involvement in Innovation Projects	0.7762	0.194405656	0.1508
Environmental	Organizational Agility	0.8099	0.054422393	0.0441
	Risk Management Strategies	0.7782	0.050068772	0.0389
Legal	Intellectual Property Management	0.7723	0.094262757	0.0728
	Intellectual Property Protection	0.7941	0.049260009	0.0391
	Regulatory Environment	0.7743	0.050799267	0.0393

4.5. Reliability Test (Cronbach's Alpha)

To test reliability, the Cronbach alpha reliability test was used to check the level of reliability of data collected from the questionnaires. This test will be used to determine the internal consistency and therefore check the reliability and validity of the responses on the survey. The following formula was used to calculate Cronbach alpha

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right)$$

Table 2: Reliability Test (Cronbach's Alpha)

K	Number of test items	**35**
∑Vi	Variance of the ith test item	**29.997**
Vt	Variance of total score	**480.775**
∝	Cronbach's Alpha	**0.97**

5. Conclusion

Leadership Commitment is recognized as the first and the most influential, meaning that it is imperative for leaders to direct original ideas and efforts. Top managers are one way in which positive innovation contributions can manifest themselves as

they support innovation and establish an environment conductive to it.

In this context, Organizational Culture is an important factor that support creation of culture that can enhance innovation. Such a culture includes risks, knowledge, and collaboration readiness to wish for innovation.

Investment in R&D is important in sustaining of innovation capabilities. Those organizations that invest in R&D are in a better place to develop new products and Technologies.

Behind Employee Training and Development, the Human Capital indicates that people should be armed with adequate skills in order to participate in innovation processes. Continuing short as well as long term training and skill upgraded measures are needed to retain a good stock of knowledgeable employees.

Technological Infrastructure contributes to the innovation process by offering the appropriate technologies. It is important in measures to ensure that technological tools being used both in the manufacturing process and in marketing are up to date.

Market Orientation is essential in assisting businesses to reorient its innovation activities in an effort to create and launch new products or deliver new services that fits the market needs.

External Collaboration and Support:

More Resources, Competence and friendly Environment by working with External Partner and favorable Government Policies give the extra edge needed to innovate. It can be seen that external partnerships provide new ideas and resources which would help to advance the process of innovation.

Intellectual Property Management (IPM) is crucial to the innovations protection and development of further investment in new ideas.

Involvement and Execution: The Fundamental Elements of innovation that include the Decision-Making Process, Active Involvement in Innovation Projects, and, Access to Innovation Resources are important for successful implementation of innovation strategies. Decision-making and project involvement guarantee that innovation processes are properly coordinated and that the respective projects are implemented to a high level of efficiency.

Success Factors: Market Demand, Availability of Skilled Workforce, Top Management Support and Financial Resources are considered to be critical success factors of innovation. The analysis of the external environment also revealed important requirements that should be met in order to achieve innovation goals: meeting market needs through people with certain skills, obtaining management support, and ensuring sufficient financial resources.

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