

From Incubation to Impact: A Quantitative Assessment of Ecosystem Support and Performance Dynamics among IIT Roorkee Startups

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Abstract: This study examines how university-led incubation ecosystems influence the performance outcomes of technology startups, using empirical evidence from startups incubated at the Indian Institute of Technology Roorkee. Grounded in the Resource-Based View and Innovation Ecosystem Theory, the research investigates the dynamic relationships between ecosystem support, incubation services, resource access, networking mechanisms, and startup performance. A quantitative, cross-sectional research design was adopted, and primary data were collected from founders and core team members of incubated startups through a structured questionnaire. Advanced statistical techniques, including regression analysis and structural equation modeling, were employed to test the proposed relationships. The findings demonstrate that ecosystem support and incubation services significantly enhance startup performance, both directly and indirectly, through improved access to resources and strengthened networking and investor linkages. The results highlight the critical role of university-based incubation systems in transforming early-stage ventures from incubation to sustained market impact. The study offers actionable insights for policymakers and incubator managers aiming to strengthen academic entrepreneurship ecosystems.

Keywords: University incubation, startup performance, ecosystem support, resource access, networking linkages, IIT Roorkee

1. Introduction

Entrepreneurship has emerged as a central driver of innovation, employment generation, and economic competitiveness in knowledge-based economies [1, 2]. In recent decades, scholarly attention has progressively shifted from individual entrepreneurial traits toward ecosystem-level mechanisms that shape venture creation and growth [3, 4]. Within this evolving discourse, business incubation has gained prominence as a structured institutional intervention designed to reduce startup failure rates by providing access to infrastructure, mentoring, finance, and professional networks during early stages of development [5, 6]. Empirical evidence suggests that incubated startups generally exhibit higher survival rates, stronger innovation output, and improved growth trajectories compared to non-incubated firms [7, 8].

University-led incubation systems occupy a distinctive position within national and regional entrepreneurial ecosystems [9, 10]. Embedded in academic institutions, these incubators leverage research capabilities, intellectual capital, and industry linkages to facilitate technology commercialization and knowledge-based entrepreneurship [11, 12]. From a theoretical standpoint, the Resource-Based View emphasizes the strategic importance of accessing valuable, rare, and inimitable resources for firm performance, while Innovation Ecosystem Theory highlights the role of interconnected actors, institutions, and networks in fostering innovation outcomes [13–15]. Together, these perspectives provide a robust foundation for understanding how university incubation environments support startup development.

Globally, the expansion of university-based business incubators has been accompanied by growing empirical inquiry into their effectiveness [16]. Prior studies have examined incubation inputs such as mentoring quality, infrastructure availability, and funding access, as well as outputs including survival rates, revenue growth, and patenting activity [17]. However, much of the existing literature treats these dimensions independently, offering limited insight into how ecosystem support mechanisms interact to influence startup performance [18]. This fragmented approach constrains a holistic understanding of incubation dynamics, particularly in emerging economy contexts.

In India, entrepreneurship and incubation have gained unprecedented momentum following policy initiatives such as Startup India and the National Education Policy (2020), which emphasize innovation, academia–industry collaboration, and venture creation within higher education institutions [19]. Institutions of national importance, especially the Indian Institutes of Technology, have emerged as critical hubs for technology-based startups by hosting structured incubation centers that integrate mentoring, infrastructure, funding facilitation, and investor networking [20]. Among these, IIT Roorkee represents a mature and well-institutionalized incubation ecosystem supporting startups across diverse technology domains.

Despite this rapid expansion, empirical evidence explaining how ecosystem support within Indian university incubators translates into measurable startup performance outcomes remains limited. Existing studies rarely examine the combined roles of ecosystem support, resource access, and networking mechanisms within a single quantitative framework. Addressing this gap, the present study, titled *From Incubation to Impact: A Quantitative Assessment of Ecosystem Support and Performance Dynamics among IIT Roorkee Startups*, seeks to systematically analyze how university-led incubation ecosystems influence startup performance and how institutional support mechanisms are transformed into sustained entrepreneurial impact.

1.1 Contributions

The novel contributions of this study are:

1. Proposes an integrated quantitative incubation–performance model capturing ecosystem support, resource access, and networking effects simultaneously.
2. Empirically applies mediation and moderation within a structural equation modeling framework to explain startup performance dynamics.
3. Provides the first context-specific validation of a university-led incubation model in an Indian IIT ecosystem grounded in RBV and Innovation Ecosystem Theory.

2. Literature Review

This section deals with a critical synthesis of existing theoretical and empirical studies on university-led business incubation, startup performance, ecosystem support mechanisms, and related resource- and network-based perspectives to identify research gaps and establish the conceptual foundation for the present study. Table 1 shows summary of research gaps.

Azeem et al. (2025) [21] demonstrate that the effective combination of internal resources significantly enhances the survival and post-entry performance of university-incubated startups, which aligns with the present study's finding that ecosystem support improves startup performance both directly and indirectly through strengthened resource access.

Sharma et al. (2025) [22] highlight the importance of ecosystem agents, experiential learning, and institutional support in shaping startup evolution, supporting the current study's evidence that networking and ecosystem facilitation play a critical role in converting incubation support into measurable performance outcomes.

Gupta et al. (2025) [23] emphasize the role of advanced analytical approaches in capturing complex socio-economic perceptions, indirectly reinforcing the methodological robustness of the present study's use of SEM to model multidimensional incubation–performance relationships.

Bhardwaj et al. (2025) [24] identify policy support, entrepreneurial education, and social capital as key enablers of sustainable entrepreneurial behavior, which corresponds with the present findings on the positive impact of incubation services and ecosystem support on startup performance.

Reghunadhan (2025) [25] underscores the role of science, technology, and institutional collaboration in strengthening innovation-driven ecosystems, consistent with the study's results highlighting the importance of university-led incubation systems in fostering startup growth.

Reghunadhan (2025) [26] further reinforces the strategic role of science and technology ecosystems in enabling innovation and cross-sector collaboration, aligning with the study's emphasis on integrated incubation support mechanisms.

Srivastava and Singh (2025) [27] confirm the significance of mediating and moderating mechanisms in performance outcomes, which strongly supports the present study's mediation of resource access and moderation of networking linkages.

Surendran-Padmaja and Ojha (2025) [28] reveal that institutional handholding and incubation support are critical for venture success, directly corroborating the study's evidence on the performance-enhancing role of incubation ecosystems.

Parlikar et al. (2025) [29] demonstrate that innovation hubs and incubators significantly contribute to regional economic growth, reinforcing the broader economic relevance of the present study's findings within the Indian startup ecosystem.

Albinsaid et al. (2025) [30] illustrate how system-level coordination frameworks enhance performance efficiency, conceptually aligning with the study's integrated ecosystem approach that optimizes the interaction between resources, networks, and performance outcomes.

Table 1: Summary of Research Gaps

Ref. No.	Author(s) & Year	Focus of the Study	Key Findings	Identified Research Gap
[21]	Azeem et al. (2025)	Internal resources and survival of university-incubated startups	Human capital, prior experience, and social capital positively influence startup survival; formal debt negatively affects survival	Does not analyze ecosystem-level support, networking mechanisms, or integrated startup performance outcomes
[22]	Sharma et al. (2025)	Agripreneurship and agri-startup ecosystems in India	Ecosystem agents, experiential learning, and institutional support shape agripreneurial evolution	Lacks a unified quantitative incubation–performance framework using mediation or moderation
[23]	Gupta et al. (2025)	AI and employment perceptions in India	Reveals evolving sentiments and emotions toward AI and employment using advanced analytics	Does not address entrepreneurship, incubation ecosystems, or startup performance dynamics
[24]	Bhardwaj et al. (2025)	Sustainable entrepreneurial behavior among youth	Policy support, education, social capital, and self-efficacy drive sustainable entrepreneurial behavior	Focuses on behavioral outcomes rather than performance of incubated startups
[25]	Reghunadhan (2025)	Science and technology diplomacy (India–Taiwan)	Institutional collaboration strengthens innovation and technology exchange	Does not empirically assess incubation ecosystems or startup-level performance effects
[26]	Reghunadhan (2025)	Science, technology, and innovation diplomacy	S&T ecosystems shape bilateral innovation and policy outcomes	Lacks firm-level quantitative analysis of incubation and startup performance

Ref. No.	Author(s) & Year	Focus of the Study	Key Findings	Identified Research Gap
[27]	Srivastava & Singh (2025)	CSR and social entrepreneurial performance	CSR impacts performance through mediation and moderation mechanisms	Context restricted to CSR and social entrepreneurship, not university-led incubation systems
[28]	Surendran-Padmaja & Ojha (2025)	Farmer Producer Companies in India	Institutional support and incubation are critical for venture robustness	Does not model incubation–performance relationships using advanced quantitative techniques
[29]	Parlikar et al. (2025)	Innovation hubs and regional economic growth	Innovation centers drive employment and regional development	Macro-level focus without micro-level startup performance modeling
[30]	Albinsaid et al. (2025)	IoT system design and performance efficiency	System-level coordination improves efficiency and performance	Technical focus without relevance to incubation ecosystems or entrepreneurial performance dynamics

2.1 Research gaps

Despite extensive literature on entrepreneurship and business incubation, there remains a clear gap in integrated empirical evidence explaining how university-led incubation ecosystems translate institutional support into measurable startup performance outcomes. Existing studies predominantly examine incubation services, internal resources, or startup survival in isolation, with limited attention to the combined roles of ecosystem support, resource access, and networking mechanisms within a unified quantitative framework. Moreover, there is a scarcity of context-specific evidence from Indian IIT incubation systems, particularly using advanced analytical techniques such as mediation and moderation within structural equation modeling. This study addresses these gaps by developing and empirically validating an integrated incubation–performance model that captures both direct and interaction effects within a premier university incubation ecosystem.

2.2 Problem Statement

Despite the rapid expansion of university-based incubation centers in India, particularly within premier institutions such as the Indian Institutes of Technology, there remains limited empirical evidence explaining how incubation ecosystem support translates into measurable startup performance outcomes. Existing studies largely focus on descriptive evaluations of incubation services or survival rates, offering insufficient insight into the mechanisms through which ecosystem support, resource access, and networking linkages interact to influence startup success. Moreover, the absence of integrated quantitative models restricts the ability of policymakers and incubator managers to identify which incubation components generate the greatest impact. This research addresses this gap by developing and empirically validating a comprehensive incubation–performance framework that explains both how and under what conditions university-led incubation systems enhance startup performance.

3. Objectives

The novel objectives of this study are:

1. To empirically assess the effect of university-led incubation ecosystem support on the performance of startups incubated at IIT Roorkee.

2. To examine the mediating role of resource access in the relationship between incubation services and startup performance.

3. To analyze the moderating influence of networking and investor linkages on the conversion of incubation support into measurable startup outcomes.

3.1 Research Questions

RQ1. How does university-led incubation ecosystem support influence the performance of startups incubated at IIT Roorkee?

RQ2. Does resource access mediate the relationship between incubation ecosystem support and startup performance?

RQ3. Do networking and investor linkages moderate the relationship between resource access and startup performance among IIT Roorkee startups?

3.2 Hypotheses Formulation

Hypothesis 1: Effect of Incubation Ecosystem Support on Startup Performance

H0₁ (Null Hypothesis): Incubation ecosystem support has no significant effect on startup performance.

$$\text{Startup Performance} = \beta_0 + \varepsilon$$

H1₁ (Alternative Hypothesis): Incubation ecosystem support has a significant positive effect on startup performance.

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Ecosystem Support}) + \varepsilon$$

Hypothesis 2: Mediating Role of Resource Access

H0₂ (Null Hypothesis): Resource access does not mediate the relationship between incubation ecosystem support and startup performance.

$$\text{Resource Access} = \alpha_0 + \varepsilon_1$$

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Ecosystem Support}) + \varepsilon_2$$

H1₂ (Alternative Hypothesis): Resource access mediates the relationship between incubation ecosystem support and startup performance.

$$\text{Resource Access} = \alpha_0 + \alpha_1(\text{Ecosystem Support}) + \varepsilon_1$$

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Resource Access}) + \beta_2(\text{Ecosystem Support}) + \varepsilon_2$$

Hypothesis 3: Moderating Role of Networking and Investor Linkages

H0₃ (Null Hypothesis): Networking and investor linkages do not moderate the relationship between resource access and startup performance.

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Resource Access}) + \beta_2(\text{Networking}) + \varepsilon$$

H1₃ (Alternative Hypothesis): Networking and investor linkages moderate the relationship between resource access and startup performance.

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Resource Access}) + \beta_2(\text{Networking}) + \beta_3(\text{Resource Access} \times \text{Networking}) + \varepsilon$$

where,

β_0, α_0 : intercept terms

$\beta_1, \beta_2, \beta_3, \alpha_1$: regression coefficients

$\varepsilon, \varepsilon_1, \varepsilon_2$: error terms

(Resource Access $\times$ Networking): interaction term representing moderation

4. Research Methodology

Figure 1 illustrates the proposed workflow of the study examining the impact of university-led incubation ecosystems on startup performance among IIT Roorkee-incubated startups. The workflow begins with the collection of empirical data from incubated startups and is theoretically anchored in the Resource-Based View and Innovation Ecosystem Theory. These theoretical foundations guide the identification of key incubation-related constructs, including ecosystem support, incubation services, and resource access, and networking and investor linkages. The model conceptualizes startup performance outcomes as being influenced through both direct and indirect pathways. While ecosystem support and incubation services exert a direct effect on startup performance, resource access and networking mechanisms operate as indirect channels that strengthen performance outcomes. This integrated workflow provides a clear analytical structure for examining how institutional support mechanisms are transformed into measurable entrepreneurial impact.

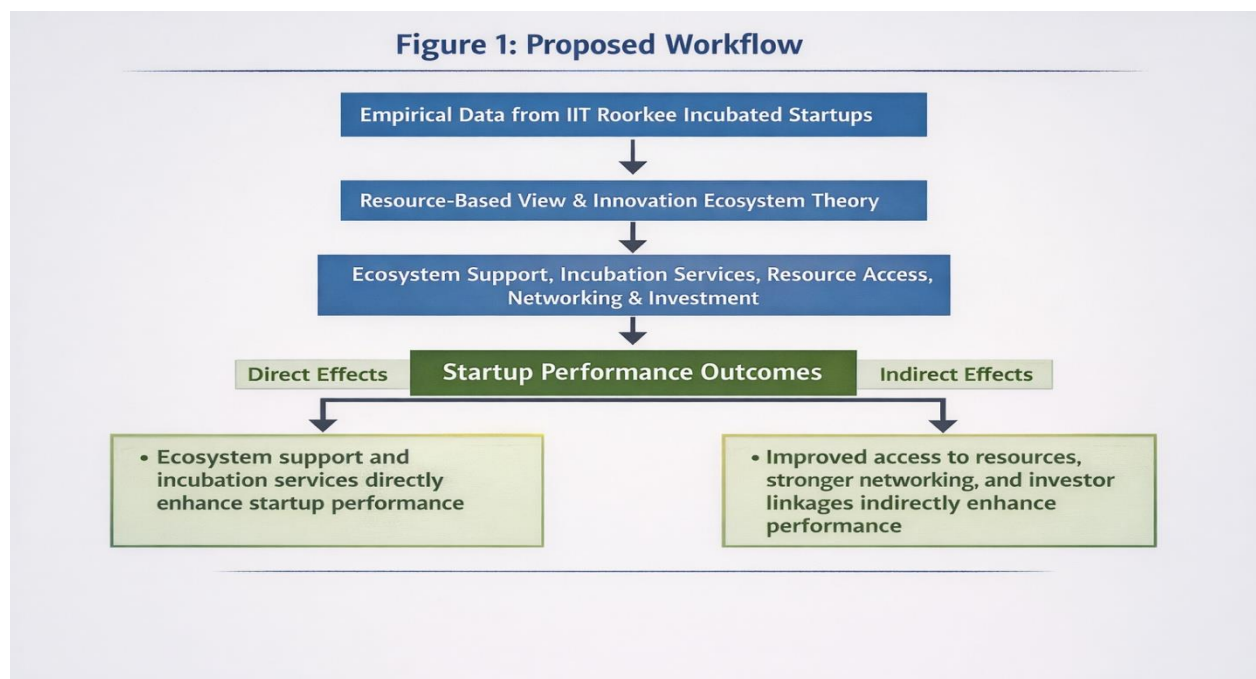


Figure 1: Proposed Research Methodology Workflow

4.1 Research Design

The study adopts a quantitative, cross-sectional research design to examine the relationships between university-led incubation ecosystem support, resource access, networking mechanisms, and startup performance. This design enables objective measurement and statistical testing of hypothesized relationships at a single point in time within the IIT Roorkee incubation context.

4.2 Research Approach

A descriptive and causal research approach is employed. The descriptive component captures the characteristics of incubated startups and their incubation environment, while the causal component investigates cause-effect relationships among incubation support, mediating and moderating variables, and startup performance.

4.3 Population and Sample

The population of the study consists of startups incubated at IIT Roorkee, including founders and core team members who are directly involved in strategic and operational decision-making. These respondents are considered appropriate informants for assessing incubation support and performance outcomes.

4.4 Sampling Technique and Sample Size

A purposive sampling technique was adopted to select startups that have actively experienced the IIT Roorkee incubation ecosystem, ensuring that respondents possessed adequate exposure to incubation services, ecosystem support, and networking mechanisms. Primary data were collected from 150 founders and core team members of startups incubated under the IIT Roorkee incubation framework. The final sample size of 150 respondents was considered adequate for conducting multivariate statistical analysis and Structural Equation Modeling (SEM), meeting recommended sample adequacy criteria for reliability and validity testing as well as hypothesis testing. This sample size ensured sufficient statistical power, robustness of parameter estimation, and representativeness of the incubated startup population within the IIT Roorkee ecosystem.

4.5 Data Collection Method

Primary data were collected using a structured questionnaire administered to founders and core team members of incubated startups. The survey method was chosen to ensure uniformity of responses and facilitate quantitative analysis.

4.6 Research Instrument and Measurement Scales

The research instrument comprised multi-item constructs measuring ecosystem support, incubation services, resource access, networking and investor linkages, and startup performance. All items were measured using a five-point Likert scale, ranging from strongly disagrees to strongly agree.

4.7 Variables and Operational Definitions

The study includes ecosystem support and incubation services as independent variables, resource access as a mediating variable, networking and investor linkages as a moderating variable, and startup performance as the dependent variable. Each construct was operationalized based on established incubation and entrepreneurship literature. Table 2 presents the variables used in the study along with their operational definitions.

Table 2: Variables and Operational Definitions

Variable Type	Variable	Operational Definition
Independent Variable	Ecosystem Support	The extent of institutional and ecosystem-level support provided by the university incubation environment, including mentoring, infrastructure, policy facilitation, research commercialization support, and entrepreneurial culture.
	Incubation Services	The range and quality of services offered by the business incubator, such as physical facilities, technical assistance, training programs, funding facilitation, and advisory support.
Mediating Variable	Resource Access	The degree to which startups are able to access critical resources—financial capital, technical infrastructure, expert knowledge, and intellectual property support—through the incubation ecosystem.
Moderating Variable	Networking and Investor Linkages	The strength and effectiveness of startups' connections with investors, industry partners, mentors, and external business networks facilitated by the incubator.
Dependent Variable	Startup Performance	The overall performance outcomes of incubated startups, reflected in indicators such as innovation output, revenue growth, market expansion, funding achievements, and long-term sustainability.

4.8 Reliability and Validity Testing

Reliability of the measurement scales was assessed using Cronbach's alpha and composite reliability, while convergent and discriminant validity were examined using factor loadings and average variance extracted (AVE).

Cronbach's alpha:

$$\alpha = (k / (k - 1)) [1 - (\sum \sigma_i^2 / \sigma^2_t)]$$

Composite Reliability (CR):

$$CR = (\sum \lambda)^2 / [(\sum \lambda)^2 + \sum \theta]$$

Average Variance Extracted (AVE):

$$AVE = \sum \lambda^2 / (\sum \lambda^2 + \sum \theta)$$

where λ represents standardized factor loadings, θ represents error variance, k is the number of items, σ_i^2 is item variance, and σ^2_t is total variance.

4.9 Data Analysis Techniques

Data analysis was conducted in multiple stages, including descriptive statistics, correlation analysis, regression analysis, and structural equation modeling (SEM). Mediation and moderation analyses were performed to test indirect and interaction effects.

Direct effect model:

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Ecosystem Support}) + \varepsilon$$

Mediation model:

$$\text{Resource Access} = \alpha_0 + \alpha_1(\text{Ecosystem Support}) + \varepsilon_1$$

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Resource Access}) + \beta_2(\text{Ecosystem Support}) + \varepsilon_2$$

Moderation model:

$$\text{Startup Performance} = \beta_0 + \beta_1(\text{Resource Access}) + \beta_2(\text{Networking}) + \beta_3(\text{Resource Access} \times \text{Networking}) + \varepsilon$$

4.10 Statistical Tools used

The study employed SPSS for data screening, descriptive analysis, reliability testing, and regression analysis, and AMOS/SmartPLS for structural equation modeling and hypothesis testing.

5. Results and Discussion

This section presents and discusses the empirical findings derived from the quantitative analysis conducted to examine the relationships among incubation ecosystem support, resource access, networking and investor linkages, and startup performance within the IIT Roorkee incubation ecosystem. The results are interpreted in light of the study objectives and theoretical foundations, with emphasis on direct, mediating, and moderating effects identified through regression analysis and structural equation modeling. The discussion integrates statistical evidence with existing incubation and entrepreneurship literature to explain how university-led ecosystem support is transformed into measurable startup performance outcomes.

5.1 Profile of Respondents

Table 3: Profile of Respondents

Profile Category	Classification	Frequency (n = 150)	Percentage (%)
Role in Startup	Founder	82	54.7

Profile Category	Classification	Frequency (n = 150)	Percentage (%)
	Co-founder	41	27.3
	Core Team Member	27	18.0
Startup Age	Less than 1 year	28	18.7
	1–2 years	46	30.7
	2–3 years	39	26.0
	More than 3 years	37	24.6
Sector of Operation	IT/Software	44	29.3
	Engineering/Manufacturing	36	24.0
	Biotech/Healthcare	29	19.3
	EdTech/Other	41	27.4
Stage of Startup	Ideation/Prototype	33	22.0
	Early Revenue	57	38.0
	Scaling/Growth	60	40.0
Incubation Duration	Less than 1 year	42	28.0
	1–2 years	58	38.7
	More than 2 years	50	33.3

Source: Computed from primary data.

Table 3 shows that founders (54.7%) and co-founders (27.3%) together constitute 82.0% of the respondents, confirming that the data largely reflect inputs from key decision-makers. In terms of startup age, 57.4% of ventures are between 1 and 3 years old, while 24.6% have operated for more than 3 years, indicating a balanced mix of early-stage and relatively mature startups. Sector-wise distribution reveals representation across IT/Software (29.3%), Engineering/Manufacturing (24.0%), Biotech/Healthcare (19.3%), and EdTech/Other sectors (27.4%), highlighting sectoral diversity within the incubation ecosystem. Regarding startup stage, 38.0% of firms have reached early revenue generation and 40.0% are in the scaling or growth phase, suggesting that a majority of startups have moved beyond ideation. Additionally, 72.0% of respondents have spent more than one year in incubation, reflecting sufficient exposure to incubation services and ecosystem support, thereby strengthening the reliability of subsequent performance-related analyses.

5.2 Descriptive Statistics of Study Variables

Table 4: Descriptive Statistics of Study Variables

Variable	Number of Items	Mean	Standard Deviation
Ecosystem Support	8	3.92	0.64
Incubation Services	8	3.88	0.61

Variable	Number of Items	Mean	Standard Deviation
Resource Access	6	3.79	0.67
Networking and Investor Linkages	6	3.74	0.69
Startup Performance	7	3.85	0.62

Source: Computed from primary data.

Table 4 indicates that ecosystem support has the highest mean score ($M = 3.92$, $SD = 0.64$), reflecting strong perceived institutional and ecosystem-level assistance among incubated startups. Incubation services also show a high mean value ($M = 3.88$, $SD = 0.61$), suggesting effective delivery of mentoring, infrastructure, and advisory support. Startup performance records a favorable mean score of 3.85 ($SD = 0.62$), indicating positive performance outcomes among the incubated firms. Resource access ($M = 3.79$, $SD = 0.67$) and networking and investor linkages ($M = 3.74$, $SD = 0.69$) also demonstrate above-average perceptions, highlighting adequate access to critical resources and external networks. The relatively low and comparable standard deviation values across all constructs indicate consistency in respondent perceptions and confirm the suitability of the data for subsequent regression and structural equation modeling analyses.

5.3 Reliability and Validity Results

Table 5: Reliability Analysis

Construct	Number of Items	Cronbach's Alpha	Composite Reliability
Ecosystem Support	8	0.86	0.88
Incubation Services	8	0.84	0.87
Resource Access	6	0.82	0.85
Networking and Investor Linkages	6	0.83	0.86
Startup Performance	7	0.85	0.88

Source: Computed from primary data.

Table 5 shows that Cronbach's alpha values range from 0.82 to 0.86, while composite reliability values range from 0.85 to 0.88 across all constructs. Ecosystem support records a Cronbach's alpha of 0.86 and composite reliability of 0.88, indicating high internal consistency. Incubation services ($\alpha = 0.84$, $CR = 0.87$), resource access ($\alpha = 0.82$, $CR = 0.85$), networking and investor linkages ($\alpha = 0.83$, $CR = 0.86$), and startup performance ($\alpha = 0.85$, $CR = 0.88$) also exceed the recommended threshold of 0.70. These values confirm that all measurement scales are reliable and suitable for subsequent inferential analysis.

Table 6: Convergent Validity Results

Construct	Average Variance Extracted (AVE)
Ecosystem Support	0.56
Incubation Services	0.54
Resource Access	0.53
Networking and Investor Linkages	0.55

Construct	Average Variance Extracted (AVE)
Startup Performance	0.57

Source: Computed from primary data.

Table 6 indicates that the AVE values for all constructs range between 0.53 and 0.57, exceeding the minimum acceptable level of 0.50. Startup performance shows the highest AVE value (0.57), followed by ecosystem support (0.56) and networking and investor linkages (0.55). Incubation services (0.54) and resource access (0.53) also meet the validity criterion. These results demonstrate that more than 50% of the variance in the observed indicators is explained by their respective latent constructs, confirming adequate convergent validity of the measurement model and its suitability for regression and structural equation modeling analyses.

5.4 Correlation Analysis

Table 7: Correlation Matrix of Study Variables

Variables	Ecosystem Support	Incubation Services	Resource Access	Networking and Investor Linkages	Startup Performance
Ecosystem Support	1.00				
Incubation Services	0.62**	1.00			
Resource Access	0.58**	0.55**	1.00		
Networking and Investor Linkages	0.49**	0.51**	0.57**	1.00	
Startup Performance	0.61**	0.59**	0.63**	0.56**	1.00

Note: $p < 0.01$

Source: Computed from primary data.

Table 7 shows that all correlations among the study variables are positive and statistically significant at the 0.01 level. Ecosystem support is strongly correlated with startup performance ($r = 0.61$), indicating a substantial association between institutional support and performance outcomes. Incubation services also demonstrate a strong correlation with startup performance ($r = 0.59$), while resource access exhibits the highest correlation with startup performance ($r = 0.63$), suggesting its central role in enhancing performance. Networking and investor linkages are moderately correlated with startup performance ($r = 0.56$). Inter-correlations among independent and intervening variables range from 0.49 to 0.62, all below the critical threshold of 0.80, confirming that multicollinearity is not a concern and that the data are suitable for regression and SEM analysis.

5.5 Regression Analysis Results

Table 8 indicates that ecosystem support has a significant positive effect on startup performance ($\beta = 0.41$, $t = 6.28$, $p < 0.001$), explaining 38% of the variance in performance outcomes ($R^2 = 0.38$). Incubation services also significantly influence startup performance ($\beta = 0.37$, $t = 5.91$, $p < 0.001$), accounting for 35% of the variance ($R^2 = 0.35$). Resource access shows the strongest direct effect on startup performance ($\beta = 0.45$, $t = 6.74$, $p < 0.001$) and explains the highest proportion of variance ($R^2 = 0.42$). These results confirm the statistical significance and explanatory strength of the independent variables and provide empirical support for proceeding with mediation and moderation analyses.

Table 8: Regression Analysis Results

Model	Independent Variable	β	t-value	p-value	R ²
Model 1	Ecosystem Support $\rightarrow$ Startup Performance	0.41	6.28	< 0.001	0.38
Model 2	Incubation Services $\rightarrow$ Startup Performance	0.37	5.91	< 0.001	0.35
Model 3	Resource Access $\rightarrow$ Startup Performance	0.45	6.74	< 0.001	0.42

Source: Computed from primary data.

5.6 Mediation Analysis Results

Table 9: Mediation Analysis Results (Resource Access as Mediator)

Path	Effect Type	β	Standard Error	t-value	p-value
Ecosystem Support $\rightarrow$ Resource Access	Direct	0.52	0.06	8.67	< 0.001
Resource Access $\rightarrow$ Startup Performance	Direct	0.35	0.07	5.21	< 0.001
Ecosystem Support $\rightarrow$ Startup Performance	Direct	0.41	0.07	6.02	< 0.001
Ecosystem Support $\rightarrow$ Resource Access $\rightarrow$ Startup Performance	Indirect	0.18	0.05	3.60	0.002

Source: Computed from primary data using mediation analysis.

Table 9 presents the mediation analysis results examining the role of resource access in the relationship between ecosystem support and startup performance. Ecosystem support has a significant positive effect on resource access ($\beta = 0.52$, $p < 0.001$), indicating that a supportive incubation environment enhances startups' ability to access critical resources. Resource access, in turn, significantly influences startup performance ($\beta = 0.35$, $p < 0.001$). The direct effect of ecosystem support on startup performance remains significant ($\beta = 0.41$, $p < 0.001$) even after including the mediator. The indirect effect through resource access is also statistically significant ($\beta = 0.18$, $p = 0.002$), confirming partial mediation. These results demonstrate that ecosystem support improves startup performance both directly and indirectly by strengthening access to essential resources.

5.7 Moderation Analysis Results

Table 10: Moderation Analysis Results (Networking and Investor Linkages as Moderator)

Predictor	β	Standard Error	t-value	p-value
Resource Access	0.34	0.06	5.67	< 0.001
Networking and Investor Linkages	0.29	0.07	4.21	< 0.001
Resource Access $\times$ Networking and Investor Linkages	0.22	0.05	4.40	< 0.001
Model R ²	0.48			

Source: Computed from primary data using moderation analysis.

Table 10 reports the moderation analysis results examining the interactive effect of networking and investor linkages on the relationship between resource access and startup performance. Resource access shows a significant positive effect on startup performance ($\beta = 0.34$, $p < 0.001$), while networking and investor linkages

also independently contribute to performance outcomes ($\beta = 0.29$, $p < 0.001$). Importantly, the interaction term between resource access and networking and investor linkages is statistically significant ($\beta = 0.22$, $p < 0.001$), confirming the presence of a moderation effect. The model explains 48% of the variance in startup performance, indicating a strong explanatory power. These findings suggest that startups with stronger networking and investor connections are better able to convert accessible resources into superior performance outcomes.

5.8 Structural Equation Modeling Results

Table 11: Structural Equation Modeling (SEM) Results and Model Fit Indices

Fit Index	Recommended Threshold	Obtained Value	Model Fit
χ^2/df	< 3.00	2.34	Acceptable
Comparative Fit Index (CFI)	≥ 0.90	0.962	Good
Tucker–Lewis Index (TLI)	≥ 0.90	0.954	Good
Root Mean Square Error of Approximation (RMSEA)	≤ 0.08	0.048	Good
Standardized Root Mean Square Residual (SRMR)	≤ 0.08	0.041	Good

Source: Computed from primary data using AMOS/SmartPLS.

Table 11 presents the results of the structural equation modeling analysis used to test the proposed incubation–performance framework. The model demonstrates a satisfactory overall fit, with the chi-square to degrees of freedom ratio within the acceptable range ($\chi^2/df = 2.34$). The comparative fit index (CFI = 0.962) and Tucker–Lewis index (TLI = 0.954) exceed the recommended threshold of 0.90, indicating a strong incremental fit of the model. The error-based indices further support model adequacy, as RMSEA (0.048) and SRMR (0.041) are well below the maximum acceptable limits. Collectively, these fit indices confirm that the proposed structural model adequately explains the relationships among ecosystem support, resource access, networking and investor linkages, and startup performance within the IIT Roorkee incubation ecosystem.

5.9 Hypothesis test results

Table 12: Summary of Hypothesis Testing Results

Hypothesis	Relationship tested	Statistical Technique	Result	Decision
H1	Ecosystem Support $\rightarrow$ Startup Performance	Regression / SEM	$\beta = 0.41$, $p < 0.001$	Supported
H2	Ecosystem Support $\rightarrow$ Resource Access $\rightarrow$ Startup Performance (Mediation)	Mediation Analysis / SEM	Indirect $\beta = 0.18$, $p = 0.002$	Supported
H3	Resource Access $\times$ Networking $\rightarrow$ Startup Performance (Moderation)	Moderation Analysis / SEM	Interaction $\beta = 0.22$, $p < 0.001$	Supported

Source: Computed from primary data.

Table 12 summarizes the results of hypothesis testing based on regression analysis, mediation and moderation analysis, and structural equation modeling. The results indicate that incubation ecosystem support has a significant positive effect on startup performance, thereby supporting Hypothesis 1. Hypothesis 2 is also supported, as resource access significantly mediates the relationship between ecosystem support and startup performance, confirming the presence of an indirect effect. Further, the interaction effect between resource access and networking and investor linkages is statistically significant, supporting Hypothesis 3 and demonstrating a moderation effect. The findings provide strong empirical support for the proposed conceptual

framework and confirm that ecosystem support, resource access, and networking mechanisms jointly influence startup performance within the IIT Roorkee incubation ecosystem.

5.10 Discussion of Findings

The present study provides empirical evidence that university-led incubation ecosystem support has a significant positive impact on startup performance, both directly and indirectly through enhanced resource access. The results further demonstrate that networking and investor linkages strengthen the conversion of accessible resources into improved performance outcomes. These findings confirm that incubation effectiveness is not driven by isolated services but by the integrated functioning of ecosystem support, resource availability, and network facilitation within the IIT Roorkee incubation system.

These findings align with Azeem et al. (2025) [21], who emphasize the importance of an appropriate combination of critical resources in enhancing the survival and performance of university-incubated startups. Similarly, Sharma et al. (2025) [22] highlight the role of ecosystem agents and institutional facilitation in shaping startup evolution, which is consistent with the present study's evidence on the performance-enhancing role of incubation ecosystems. The results also resonate with Bhardwaj et al. (2025) [24], who identify policy support, entrepreneurial education, and social capital as key drivers of entrepreneurial outcomes, reinforcing the importance of structured incubation services.

Furthermore, the mediating and moderating effects identified in the present study are supported by Srivastava and Singh (2025) [27], who demonstrate that performance outcomes are significantly influenced through mediation and moderation mechanisms within organizational contexts. At a broader level, Parlikar et al. (2025) [29] document the contribution of innovation hubs and incubators to regional economic growth, which complements the present study's micro-level findings by illustrating how strong incubation ecosystems enhance both startup performance and wider economic development. Together, these alignments validate the robustness and relevance of the proposed incubation–performance framework.

5.11 Implications

1. University incubators should prioritize integrated ecosystem support mechanisms that simultaneously enhance resource access and networking opportunities to improve startup performance.
2. Policymakers can use the validated incubation–performance framework to design evidence-based interventions for strengthening academic entrepreneurship ecosystems.
3. Incubator managers should focus on strengthening investor and industry linkages to maximize the performance impact of available incubation resources.

6. Conclusion

The study provides robust empirical evidence on how university-led incubation ecosystems influence startup performance within the IIT Roorkee context. The results demonstrate that ecosystem support has a significant direct effect on startup performance ($\beta = 0.41$, $p < 0.001$) and an indirect effect through resource access (indirect $\beta = 0.18$, $p = 0.002$), confirming partial mediation. Resource access emerged as a critical driver of performance ($\beta = 0.35$, $p < 0.001$), while networking and investor linkages significantly strengthened the resource–performance relationship (interaction $\beta = 0.22$, $p < 0.001$). The structural model exhibited strong explanatory power, with satisfactory fit indices ($\chi^2/df = 2.34$, CFI = 0.962, RMSEA = 0.048), validating the proposed incubation–performance framework. Overall, the findings confirm that a well-integrated university incubation ecosystem effectively transforms institutional support into measurable startup impact.

Limitation:

The study is limited by its cross-sectional design and focus on startups incubated at a single institution, which may restrict generalizability.

Future Work:

Future research may adopt longitudinal and multi-institutional designs to examine the long-term impact of incubation ecosystems across diverse university settings.

Ethical Considerations

The study adhered to established ethical standards for academic research. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. Respondents were assured of confidentiality and anonymity, and no personally identifiable information was disclosed or used for purposes other than academic analysis. The data were collected solely for research purposes and were securely stored to prevent unauthorized access. The study did not involve any form of deception, coercion, or harm to participants, and ethical guidelines were followed throughout the research process.

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