



Impact of Performance of Business Incubation Centers on Startups: An Empirical Study of Karnataka

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Abstract

This empirical study evaluates the performance of Business Incubation Centers (BICs) using Input, Process, and Output Key Performance Indicators (KPIs) and examine the impact of performance of Business Incubation Centers on the startups in Karnataka for the period 2015-2025 covering a sample of 151 Business Incubation Centers. Descriptive statistics and multiple regression analysis were employed, with the total number of startups as the dependent variable and selected Input and Process-KPIs as independent variables. Regression assumptions including multicollinearity, normality, homoscedasticity, and autocorrelation were tested to ensure model validity. The findings indicate moderate gaps in input factors such as staffing, incubation capacity, and funding access, though select districts perform relatively better. Process KPIs show stronger performance, with most incubators meeting ideal standards in governance, strategy, mentoring, and compliance, despite some variation in leadership and responsiveness. Output KPIs demonstrate robust results across the state, including high revenue generation, employment creation, commercialization, and patent activity. Overall, the study concludes that Karnataka's BICs effectively translate resources and processes into tangible startup outcomes, contributing positively to entrepreneurship and economic development. The regression results reveals that the model explaining the number of startups is statistically significant and highly robust ($R^2 = 0.998$; $p = 0.000$). Diversity of Funding Resources has a positive and significant impact on startup numbers, making it the key driver of startup growth. Incubation Services provided shows a significant negative effect, while all other variables are statistically insignificant. Diagnostic tests confirm that the model satisfies major regression assumptions. Overall, funding diversity emerges as the most influential factor in determining the number of startups in Karnataka.

Keywords: Performance, Business Incubation, Startups, BICs, KPIs

Introduction

Business Incubation Centers (BICs) play a pivotal role in fostering entrepreneurship by providing startups with critical resources such as infrastructure, mentoring, financial guidance, networking opportunities, and technological support. In emerging economies like India, incubation ecosystems have become instrumental in promoting innovation-driven growth and employment generation. Karnataka, being one of the leading startup hubs in India, hosts a significant number of Business Incubation Centers across technology, biotechnology, healthcare, agriculture, and social innovation sectors.

The performance of BICs is generally evaluated through Key Performance Indicators (KPIs), which may be

categorized into Input, Process, and Output indicators. Input KPIs reflect resource availability such as infrastructure, funding, and staff strength. Process KPIs capture operational efficiency, mentoring quality, and networking activities. Output KPIs indicate tangible outcomes such as number of startups graduated, funds raised, employment generated, revenue growth, patents filed, and survival rate of startups. While several studies have examined the operational aspects and challenges of incubators, limited empirical research has been conducted to systematically measure how the performance of BICs influences startup success outcomes, particularly in the regional context of Karnataka. Given Karnataka's prominence in India's startup ecosystem, it becomes essential to empirically assess whether high-

performing incubation centers significantly contribute to startup growth and sustainability.

This study aims to empirically analyze the relationship between the performance of Business Incubation Centers and startup outcomes in Karnataka, thereby contributing to both academic literature and policy formulation.

Review of Literature

Mian S. A (1996) ^[1] examined university technology business incubators in the United States and found that incubated firms benefited significantly from university linkages, shared services, and advisory support. The study concluded that incubators add value by enhancing startup survival rates, technological capability, and early-stage growth performance.

Hackett and Dilts (2004) ^[2] developed a real-options-driven theory of business incubation and analyzed incubator outcomes. Their study revealed that selective admission processes, monitoring, and structured support systems significantly improved the survival probability and long-term viability of incubated startups compared to non-incubated firms.

Barbero, Casillas, Ramos, and Guitart (2012) ^[7] investigated how different types of incubators affect firm performance. The findings indicated that private and university-based incubators had stronger positive impacts on employment growth, innovation output, and competitiveness than public incubators, suggesting that incubator typology influences startup outcomes.

Bruneel, Ratinho, Clarysse, and Groen (2012) ^[8] analyzed the evolution of business incubators and found that modern incubators offering knowledge-intensive services such as mentoring, networking, and strategic guidance contributed more significantly to startup growth than traditional infrastructure-focused models.

Ayatse, Kwahar, and Iyortsuun (2017) ^[5] conducted an empirical review of incubation processes and firm performance. Their findings showed a positive and significant relationship between incubation services and startup performance indicators such as revenue growth, employment generation, and innovation capability.

Mian, Lamine, and Fayolle (2016) ^[4] provided an overview of technology business incubation research and concluded that incubators function as learning and networking platforms that enhance entrepreneurial competencies, innovation performance, and access to strategic resources, thereby strengthening startup sustainability.

Hausberg and Korreck (2020) ^[6] carried out a systematic literature review on business incubators and accelerators. The study concluded that incubation generally improves startup survival, innovation, and funding access, although outcomes vary depending on governance structure, regional ecosystem, and service quality.

Leitão, Pereira, and Gonçalves (2022) ^[6] reviewed global literature on incubators and startup performance and found that incubation positively influences financial performance, innovation output, and growth. The study also highlighted the need for region-specific empirical studies, particularly in developing economies.

Somsuk and Laosirihongthong (2014) ^[3] examined enabling factors for effective management of university business incubators and found that strategic management practices,

institutional support, and stakeholder collaboration significantly influence incubator effectiveness and startup success rates.

Panakaje, Bhagwath, and Kumar (2024) ^[10] analyzed the role of business incubation centers in Karnataka and reported that incubated startups demonstrated better early-stage development, improved access to mentorship and funding, and stronger networking capabilities compared to non-incubated ventures, emphasizing the importance of regional incubation ecosystems.

Research Gap

Although business incubation has been extensively discussed in entrepreneurship literature, several critical gaps remain unaddressed. Most existing studies evaluate incubator performance in isolation, focusing on operational efficiency or descriptive assessments, without statistically examining its direct impact on startup performance. Comprehensive KPI-based evaluations are relatively rare, as only a limited number of studies integrate Input, Process, and Output Key Performance Indicators simultaneously to assess their influence on startup success. Furthermore, despite Karnataka being one of India's most vibrant startup ecosystems, there is a scarcity of focused regional-level empirical research examining how incubation performance affects startup outcomes within the state. Additionally, the comparative influence of different KPI dimensions whether Input, Process, or Output indicators exert greater impact on startup performance remains largely unexplored. Therefore, there is a clear need for a structured empirical investigation that systematically and statistically examines the impact of Business Incubation Center performance on startup success in Karnataka.

Objective of the Study

1. To evaluate the performance of Business Incubation Centers using Input, Process, and Output KPIs in Karnataka.
2. To examine the impact of performance of Business Incubation Centers on the startups in Karnataka.

Hypothesis of Statements

H₀: There is no significant impact of Business Incubation Center performance on startup performance in Karnataka.

H₁: There is a significant impact of Business Incubation Center performance on startup performance in Karnataka.

Research Methodology

The present study adopts empirical research design to examine the impact of the performance of Business Incubation Centers on startup performance in Karnataka. The study is empirical in nature and is based exclusively on secondary data. Study follows mixed data primary through structured questionnaires and Secondary data are collected from published reports of Business Incubation Centers, government publications, Startup Karnataka and Startup India reports, annual reports, policy documents, research journals, and authenticated databases. The period of the study covers ten years from 2015 to 2025, enabling a comprehensive assessment of incubation performance and

startup outcomes over time. The study considers a sample size of 151, comprising selected Business Incubation Centers operating in Karnataka chosen based on data availability and consistency across the study period.

The Mean analysis to assess the average performance of Business Incubation Centers and startups, and Regression Analysis and the necessary assumptions of regression including multicollinearity, normality-Shapiro Wilk test homoscedasticity-Breusch Pagan test, and autocorrelation-Durbin Watson test are tested to ensure the robustness and validity of the results.

The total number of startups as Dependent variable and Incubator Staff to incubated Startup Ratio, Total Number of Startup Incubated Annually, Fractions of Seats Utilized in the Incubator, Acceptance Rate of Incubatees, Incubation

Services Provided by Incubators and Diversity of Funding Resources Accessed by Incubator of Input-KPIs as Independent Variables and CEO Credential, Incubator Responsiveness Incubators Active Network Partners, Quality of No. of Workshops Events, Incubators Quality of Workshop and Events Held, Suite of Services Provided by the Incubators, Existence of vision and 5 year Strategy Plan for Incubators, Well Defined Process for Incubatee Selection, Regular Review/Audit for Compliance with Vision Statement and Formally Outlined Mentoring and Evaluation Process of Process-KPIs as Independent Variables.

Results and Discussion

Table 1: District-wise Performance of BICs using Input-Key Performance Indicators (KPIs) in Karnataka

Input Key Performance Indicators (KPIs)								
Districts	No. of BICs	No. of Startups	ISISR	TNSIA	FSUI (%)	ARI (%)	ISPBI	DFRABI
Ideal Value of each KPI	-	-	0.20	25	100	100	25	100
Bagalakote	2	38	0.41	2.50	78.00	40.00	4.10	26.00
Ballari	2	77	1.80	0.42	57.50	41.47	0.53	23.00
Bangalore	89	8094	0.18	7.97	61.96	47.37	10.23	6963.11
Belagavi	4	354	0.66	1.46	55.00	67.06	1.79	31.00
Bidar	1	102	0.30	4.17	24.00	40.00	5.00	40.00
Bijapur	3	163	0.49	1.75	80.53	39.56	2.10	50.67
Chikkaballapur	1	25	1.50	0.33	32.00	58.00	0.40	28.00
Dakshina Kannada	4	173	1.31	0.69	53.58	66.13	1.39	10.50
Davanager	3	129	3.00	0.50	89.48	41.33	0.63	25.00
Dharwad	7	218	0.40	4.77	74.99	53.36	9.15	172.29
Kalaburagi	2	75	1.63	0.71	15.20	72.50	0.88	30.00
Mandya	3	130	0.31	1.72	54.86	64.14	2.52	208.33
Mangalore	12	390	0.17	4.05	55.77	64.23	6.99	249.00
Mysuru	8	400	0.45	2.39	58.79	58.68	3.45	221.28
Ramanagar	1	70	1.00	0.42	14.00	27.00	0.71	8.00
Shivamoga	2	120	0.81	0.75	57.49	58.77	0.90	48.00
Tumkur	2	80	1.60	1.29	41.77	73.17	1.88	30.00
Udupi	4	133	0.07	12.29	33.08	60.10	21.25	479.00
Uttar Kannada	1	30	0.83	1.00	32.00	41.00	1.20	10.00
Mean	7.947	568.474	0.890	2.588	51.053	53.361	3.952	455.430

Note: ISISR denotes Incubator Staff to incubated Startup Ratio (Year), TNSIA denotes Total Number of Startup Incubated Annually, FSUI denotes Fractions of Seats Utilized in the Incubator (%), ARI denotes Acceptance Rate of Incubatees (%), ISPBI denotes Incubation Services Provided by Incubators and DFRABI denotes Diversity of Funding Resources Accessed by Incubator (Lakhs).

The analysis of district-wise performance of BICs using Input KPIs across Karnataka. For the Incubator Staff to Incubated Startup Ratio shows that the almost all districts outperform the benchmark, including Bagalakote (0.41), Ballari (1.80), Belagavi (0.66), Bidar (0.30), Bijapur (0.49), Chikkaballapur (1.50), Dakshina Kannada (1.31), Davanager (3.00), Dharwad (0.40), Kalaburagi (1.63), Mandya (0.31), Mysuru (0.45), Ramanagar (1.00), Shivamoga (0.81), Tumkur (1.60), Udupi (0.07 – below ideal), Uttar Kannada (0.83), Mangalore (0.17 – below ideal), and Bangalore (0.18 – below ideal). Except Bangalore, Mangalore, and Udupi, all other districts show better staffing levels than the ideal benchmark. With regard to the Total Number of Startups Incubated Annually, none of the districts exceed the ideal benchmark. Even the highest value recorded in Udupi (12.29), followed by Bangalore (7.97), Dharwad (4.77), Bidar (4.17), and Mangalore (4.05), remains below the prescribed standard. Districts such as Ballari (0.42), Ramanagar (0.42), Davanager (0.50),

Kalaburagi (0.71), Shivamoga (0.75), Uttar Kannada (1.00), Tumkur (1.29), Belagavi (1.46), Mandya (1.72), Bijapur (1.75), Mysuru (2.39), and Bagalakote (2.50) also underperform, indicating overall shortfall in annual incubation capacity across all districts. In terms of Fraction of Seats Utilized in the Incubator, no district surpasses the ideal benchmark. Davanager (89.48), Bijapur (80.53), Bagalakote (78.00), Dharwad (74.99), Bangalore (61.96), Mysuru (58.79), Shivamoga (57.49), Ballari (57.50), Dakshina Kannada (53.58), Mandya (54.86), Belagavi (55.00), Mangalore (55.77), Tumkur (41.77), Udupi (33.08), Chikkaballapur (32.00), Uttar Kannada (32.00), Bidar (24.00), Kalaburagi (15.20), and Ramanagar (14.00) all fall below the ideal level, showing underutilization of incubation capacity statewide.

For the Acceptance Rate of Incubatees, none of the districts achieve or exceed the benchmark. Tumkur (73.17), Kalaburagi (72.50), Belagavi (67.06), Dakshina Kannada (66.13), Mangalore (64.23), Mandya (64.14), Udupi (60.10),

Shivamoga (58.77), Mysuru (58.68), Chikkaballapur (58.00), Dharwad (53.36), Bangalore (47.37), Ballari (41.47), Davanager (41.33), Uttar Kannada (41.00), Bagalakote (40.00), Bidar (40.00), Bijapur (39.56), and Ramanagar (27.00) remain below the ideal standard, indicating that all districts underperform in this KPI. Concerning Incubation Services Provided by Incubators shows that no district exceeds the ideal benchmark. Udupi (21.25) records the highest value but remains below the standard, followed by Bangalore (10.23), Dharwad (9.15), Mangalore (6.99), Bidar (5.00), Bagalakote (4.10), Mysuru (3.45), Mandya (2.52), Bijapur (2.10), Tumkur (1.88), Belagavi (1.79), Dakshina Kannada (1.39), Uttar Kannada (1.20), Shivamoga (0.90), Kalaburagi (0.88), Ramanagar (0.71), Davanager (0.63), Ballari (0.53), and Chikkaballapur (0.40), showing universal underperformance in service diversification. Finally, for Diversity of Funding Resources Accessed by Incubator reveals that the Bangalore (6963.11), Udupi (479.00), Mangalore (249.00), Mysuru (221.28), Mandya (208.33), and Dharwad (172.29) exceed the ideal benchmark and therefore outperform significantly. The remaining districts-Bagalakote (26.00), Ballari (23.00), Belagavi (31.00), Bidar (40.00), Bijapur (50.67), Chikkaballapur (28.00), Dakshina Kannada (10.50),

Davanager (25.00), Kalaburagi (30.00), Ramanagar (8.00), Shivamoga (48.00), Tumkur (30.00), and Uttar Kannada (10.00) remain below the benchmark.

Overall, the mean Incubator Staff to Incubated Startup Ratio (0.890) exceeds the ideal value of 0.20, indicating better staffing availability at the state level. Similarly, the mean value for Diversity of Funding Resources Accessed by Incubators (455.430) is substantially higher than the ideal benchmark of 100, reflecting strong overall performance in terms of funding access and financial linkages. However, Karnataka underperforms in several other input dimensions, as the mean Total Number of Startups Incubated Annually (2.588) remains far below the ideal value of 25, the mean Fraction of Seats Utilized in Incubators (51.053%) is significantly lower than the ideal 100 percent, and the mean Acceptance Rate of Incubatees (53.361%) also falls short of the benchmark. Further, the mean Incubation Services Provided by Incubators (3.952) is considerably below the ideal value of 25, indicating limited service diversification. Thus, while Karnataka demonstrates relative strength in staffing levels and funding diversity, the overall input performance suggests the need for substantial improvement in incubation capacity, infrastructure utilization, acceptance efficiency, and service provision across the state.

Table 2: District-wise Performance of BICs using Process-Key Performance Indicators (KPIs) in Karnataka

Process Key Performance Indicators (KPIs)												
Districts	CEOE	IR	IANP	NQWS	IQWEH	SSPBI	EV&SP	WDPIs	RR/ACVS	FOMEP	IEG	RDC&GI
Ideal Value of each KPI	10	10	6	-	10	10	10	10	10	10	10	10
Bagalakote	7.80	4.95	11.39	8.50	10.00	7.50	10.00	10.00	10.00	10.00	8.75	10.00
Ballari	4.44	6.60	13.30	7.50	10.00	9.50	10.00	10.00	10.00	10.00	6.25	10.00
Bangalore	9.33	6.23	14.72	13.29	10.00	9.73	10.00	10.00	10.00	10.00	9.24	10.00
Belagavi	3.81	4.95	16.44	5.00	10.00	9.75	10.00	10.00	10.00	10.00	8.75	7.50
Bidar	6.48	6.60	10.82	14.00	10.00	10.00	10.00	10.00	10.00	10.00	10.000	10.000
Bijapur	4.19	0.00	11.33	5.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Chikkaballapur	4.56	0.00	10.83	4.00	10.00	10.00	10.00	10.00	10.00	10.00	7.500	0.000
Dakshina Kannada	4.71	4.95	33.26	5.00	10.00	8.50	10.00	10.00	10.00	10.00	8.13	10.00
Davanager	6.88	6.60	18.07	10.67	10.00	9.33	10.00	10.00	10.00	10.00	8.333	6.667
Dharwad	5.78	5.66	11.34	20.43	10.00	7.14	10.00	10.00	10.00	10.00	8.57	7.14
Kalaburagi	4.38	4.95	19.99	8.00	10.00	9.50	10.00	0.00	10.00	10.00	7.50	10.00
Mandya	4.52	6.60	35.69	5.67	10.00	9.00	10.00	10.00	10.00	10.00	9.17	6.67
Mangalore	7.61	5.78	11.76	15.08	10.00	7.25	10.00	10.00	10.00	10.00	7.29	5.00
Mysuru	7.61	5.78	19.72	6.50	10.00	9.13	10.00	10.00	10.00	10.00	7.813	3.750
Ramanagar	3.00	0.00	11.59	5.00	10.00	7.00	10.00	10.00	10.00	10.00	5.00	0.00
Shivamoga	4.92	4.95	15.90	6.50	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Tumkur	9.60	8.25	19.02	25.00	10.00	9.00	10.00	10.00	10.00	10.00	7.50	10.00
Udupi	7.08	4.95	12.04	10.00	10.00	7.25	10.00	10.00	10.00	10.00	9.38	2.50
Uttar Kannada	4.44	3.30	11.35	5.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Mean	5.849	4.794	16.239	9.481	10.000	8.925	10.000	9.474	10.000	10.000	8.377	7.328

Note: CEOE denotes CEO Experience, IR denotes Incubator Responsiveness, IANP denotes Incubators Active Network Partners, NQWS denotes Number of Quality Workshops, IQWEH denotes Incubators Quality of Workshop and Events Held, SSPBI denotes Suite of Services Provided by the Incubators, EV&SP denotes Existence of vision and 5 year Strategy Plan for Incubators, WDPIs denotes Well Defined Process for Incubatee Selection, RR/ACVS denotes Regular Review/Audit for Compliance with Vision Statement, FOMEP denotes Formally Outlined Monitoring and Evaluation Process, IEG denotes Incubators External Governance and RDC&GI denotes Repository of Data Current and Graduated Incubatees.

The District-wise performance of BICs using Process-KPIs in Karnataka. In CEO Credential shows that none of the districts outperform or meet the ideal value. All districts like Bagalakote (7.80), Ballari (4.44), Bangalore (9.33), Belagavi (3.81), Bidar (6.48), Bijapur (4.19), Chikkaballapur (4.56), Dakshina Kannada (4.71), Davanager (6.88), Dharwad (5.78), Kalaburagi (4.38), Mandya (4.52), Mangalore (7.61), Mysuru (7.61),

Ramanagar (3.00), Shivamoga (4.92), Tumkur (9.60), Udupi (7.08), and Uttar Kannada (4.44), remain below the ideal benchmark, indicating uniform underperformance in leadership credentials across Karnataka. Incubator Responsiveness indicates that all districts underperform on this KPI. Extremely low responsiveness is observed in Bijapur, Chikkaballapur, and Ramanagar (0.00 each), while comparatively higher yet still inadequate levels are seen in

Tumkur (8.25), Ballari, Bidar, Mandya, and Davanager (6.60 each). Other districts including Bagalakote, Belagavi, Dakshina Kannada, Kalaburagi, Shivamoga, and Udupi (4.95 each) also fall short of the ideal, indicating a statewide responsiveness gap. Incubators' Active Network Partners highlights that the all districts outperform in Karnataka. Very strong networking is evident in Mandya (35.69), Dakshina Kannada (33.26), Kalaburagi (19.99), Mysuru (19.72), Tumkur (19.02), Davanager (18.07), Belagavi (16.44), Shivamoga (15.90), Bangalore (14.72), Ballari (13.30), Udupi (12.04), Mangalore (11.76), Ramanagar (11.59), Bijapur (11.33), Dharwad (11.34), Uttar Kannada (11.35), Bagalakote (11.39), Bidar (10.82), and Chikkaballapur (10.83), indicating excellent ecosystem connectivity across Karnataka.

Quality of Number of Workshops/Events shows the Tumkur (25.00), Dharwad (20.43), Mangalore (15.08), Bidar (14.00), Bangalore (13.29), Davanager (10.67), and Udupi (10.00). Lower activity is observed in Chikkaballapur (4.00), Belagavi, Bijapur, Ramanagar, and Uttar Kannada (5.00 each), showing variation in capacity-building intensity across districts. Quality of Workshops and Events Held, All districts record 10 meaning every district meets the ideal benchmark, reflecting uniform quality standards in training and events statewide. The Suite of Services Provided by Incubators, Districts that meet the ideal include Bidar, Bijapur, Chikkaballapur, Shivamoga, and Uttar Kannada (10.00 each). All remaining districts Bagalakote, Ballari, Bangalore, Belagavi, Dakshina Kannada, Davanager, Dharwad, Kalaburagi, Mandya, Mangalore, Mysuru, Ramanagar, Tumkur, and Udupi underperform to varying degrees, indicating limited service diversification.

Existence of Vision and 5-Year Strategy Plan, All districts meet the ideal value (10.00), indicating strong strategic orientation and long-term planning across Karnataka's incubation ecosystem. Well-Defined Process for Incubatee Selection, All districts except Kalaburagi (0.00) meets the ideal benchmark. This suggests robust and transparent selection mechanisms across most districts, with Kalaburagi as a notable exception. Regular Review/Audit for Compliance shows the each district records 10.00, indicating complete compliance with internal review and audit mechanisms statewide. Formally Outlined Mentoring and Evaluation Process, All districts meet the ideal benchmark, reflecting strong mentoring and evaluation frameworks across Karnataka. Incubators' External Governance, Districts meeting the ideal include Bidar, Bijapur, Shivamoga, and Uttar Kannada. All other districts Bagalakote, Ballari, Bangalore, Belagavi, Chikkaballapur, Dakshina Kannada, Davanager, Dharwad, Kalaburagi, Mandya, Mangalore, Mysuru, Ramanagar, Tumkur, and Udupi remain below the benchmark, indicating scope for strengthening external oversight. Repository of Data on Current and Graduated Incubatees, Districts meeting the ideal are Bagalakote, Ballari, Bangalore, Bidar, Bijapur, Dakshina Kannada, Shivamoga, Tumkur, and Uttar Kannada. Underperformance is observed in Belagavi, Davanager, Dharwad, Mandya, Mangalore, Mysuru, Udupi, and severe gaps are seen in Chikkaballapur and Ramanagar (0.00), highlighting weaknesses in data management.

Overall, the mean CEO Credential (5.849) and Incubator Responsiveness (4.794) are well below the ideal value of 10,

indicating weaknesses in leadership strength and operational responsiveness. In contrast, the mean value for Active Network Partners (16.239) exceeds the ideal benchmark of 6, reflecting strong networking capacity across the state. The mean Quality of Workshops and Events Held (10), Existence of Vision and 5-Year Strategy Plan (10), Regular Review/Audit (10), and Formally Outlined Mentoring and Evaluation Process (10) meet ideal standards, indicating robust institutional and governance structures. However, the mean Suite of Services Provided (8.925), Well-Defined Incubatee Selection Process (9.474), External Governance (8.377), and Repository of Incubatee Data (7.328) remain below the ideal value of 10, suggesting scope for improvement in service diversification, procedural clarity, external oversight, and data management. Overall, Karnataka performs strongly in networking and internal governance processes, while leadership quality, responsiveness, and supporting systems require strengthening.

Table 3: District-wise Performance of BICs using Output-Key Performance Indicators (KPIs) in Karnataka

Output Key Performance Indicators (KPIs)						
Districts	DISR	Anepis	Efrpis	Aargis	Fiscpal	Fispfg
Ideal Value of each KPI	0.1	5	20	10	0.5	0.25
Bagalakote	0.05	3.08	3.58	40.00	0.32	0.40
Ballari	0.00	3.20	4.70	47.50	1.28	0.76
Bangalore	0.03	5.21	202.82	107.09	0.54	0.66
Belagavi	0.15	7.42	4.21	66.75	0.86	0.62
Bidar	0.08	10.00	8.00	55.00	0.52	0.48
Bijapur	0.23	7.94	12.72	63.33	0.77	1.51
Chikkaballapur	0.00	10.00	11.25	32.00	2.00	1.25
Dakshina Kannada	0.17	6.58	2.31	61.75	0.78	0.65
Davanager	0.00	18.83	17.00	65.33	1.93	0.93
Dharwad	0.04	13.56	24.98	102.86	0.99	0.85
Kalaburagi	0.09	6.61	4.97	55.00	0.74	0.46
Mandya	0.04	15.10	18.45	65.67	1.30	1.18
Mangalore	0.04	4.39	18.53	70.00	0.45	0.51
Mysuru	0.07	5.96	13.27	65.63	0.75	0.69
Ramanagar	0.00	11.25	5.00	35.00	2.50	0.88
Shivamoga	0.10	5.00	9.38	56.00	0.96	0.28
Tumkur	0.08	8.08	2.85	57.50	2.15	1.83
Udupi	0.01	3.67	10.49	98.75	0.43	0.45
Uttar Kannada	0.20	12.00	5.00	70.00	1.00	1.70
Mean	0.073	8.309	19.974	63.956	1.067	0.847

Note: DISR denotes Dropout/Incubated Startup Ratio, ANEPIS denotes Average Number of Employees Per Incubated Startups, EFRPIS denotes External Funds Raised Per Incubated Startup (Lakhs), AARGIS denotes Average Annual Revenue Generated by the Incubated Startup (Lakhs), FISCPAL denotes Fraction of Incubated Startups with Commercialized Products/Apps Launched and FISPFPG denotes Fraction of Incubated Startups with Patent Filed/Granted.

District-wise Performance of BICs using Output-KPIs in Karnataka. For the Dropout/Incubated Startup Ratio: The lower values indicate better startup retention; however, as per the ideal benchmark, values below or equal to 0.10 are considered acceptable. Most districts such as Bagalakote (0.05), Ballari (0.00), Bangalore (0.03), Bidar (0.08), Chikkaballapur (0.00), Davanager (0.00), Dharwad (0.04), Kalaburagi (0.09), Mandya (0.04), Mangalore (0.04), Mysuru (0.07), Ramanagar (0.00), Tumkur (0.08), and Udupi (0.01) perform better than the ideal benchmark.

Shivamoga (0.10) exactly meets the ideal value. In contrast, Belagavi (0.15), Dakshina Kannada (0.17), Bijapur (0.23), and Uttar Kannada (0.20) exceed the ideal threshold, indicating relatively higher dropout rates. With respect to the Average Number of Employees per Incubated Startup: The most districts shows outperform in Karnataka, reflecting strong employment generation. Districts such as Bidar (10.00), Bijapur (7.94), Chikkaballapur (10.00), Dakshina Kannada (6.58), Davanager (18.83), Dharwad (13.56), Kalaburagi (6.61), Mandya (15.10), Mysuru (5.96), Ramanagar (11.25), Shivamoga (5.00), Tumkur (8.08), and Uttar Kannada (12.00) exceed or meet the ideal value. Bangalore (5.21) marginally exceeds the benchmark. However, Bagalakote (3.08), Ballari (3.20), Mangalore (4.39), and Udupi (3.67) remain below the ideal level. Regarding External Funds Raised per Incubated Startup: This KPI shows that the Bangalore (₹202.82 lakhs) and Dharwad (₹24.98 lakhs) clearly outperform the benchmark. Remaining districts like Mandya (₹18.45 lakhs), Mangalore (₹18.53 lakhs), Davanager (₹17.00 lakhs), Mysuru (₹13.27 lakhs), Bijapur (₹12.72 lakhs), Chikkaballapur (₹11.25 lakhs), and Udupi (₹10.49 lakhs) indicating limited external funding mobilization in most districts.

In terms of Average Annual Revenue Generated by Incubated Startups: All districts substantially outperform the benchmark. Particularly strong performance is observed in Bangalore (₹107.09 lakhs), Dharwad (₹102.86 lakhs), Udupi (₹98.75 lakhs), Uttar Kannada and Mangalore (₹70.00 lakhs each), and Mandya (₹65.67 lakhs). Even the lowest performing districts such as Bagalakote (₹40.00 lakhs) and Chikkaballapur (₹32.00 lakhs) exceed the ideal value, indicating robust revenue outcomes across Karnataka. For the Fraction of Incubated Startups with Commercialized Products or Apps Launched: A majority of districts outperform the benchmark. High commercialization is observed in Ramanagar (2.50), Tumkur (2.15), Chikkaballapur (2.00), Davanager (1.93), Mandya (1.30), Ballari (1.28), Belagavi (0.86), Bijapur (0.77), Mysuru (0.75), Kalaburagi (0.74), Dakshina Kannada (0.78),

Dharwad (0.99), Shivamoga (0.96), and Uttar Kannada (1.00). Bangalore (0.54) and Bidar (0.52) marginally exceed the benchmark. In contrast, Bagalakote (0.32), Mangalore (0.45), and Udupi (0.43) fall below the ideal value. Finally, for the Fraction of Incubated Startups with Patents Filed or Granted: All districts outperform the benchmark, indicating strong innovation output across Karnataka. Exceptional performance is observed in Tumkur (1.83), Uttar Kannada (1.70), Bijapur (1.51), Chikkaballapur (1.25), Mandya (1.18), Davanager (0.93), Dharwad (0.85), Mysuru (0.69), Bangalore (0.66), Dakshina Kannada (0.65), Belagavi (0.62), and Ballari (0.76). Even districts with comparatively lower values such as Shivamoga (0.28) and Bagalakote (0.40) exceed the ideal benchmark.

Overall, the mean Dropout/Incubated Startup Ratio is 0.073, which is lower than the ideal value of 0.10, indicating better-than-expected startup retention across districts. The mean Average Number of Employees per Startup stands at 8.309, significantly exceeding the ideal benchmark of 5, reflecting strong employment generation capacity. The mean External Funds Raised per Startup is ₹19.974 lakhs, which is marginally below the ideal value of ₹20 lakhs, suggesting that, although a few districts like Bangalore and Dharwad perform exceptionally well, overall funding mobilization is slightly below the desired level. The mean Average Annual Revenue per Startup is ₹63.956 lakhs, far above the ideal value of ₹10 lakhs, demonstrating robust financial performance and commercialization success across Karnataka. Similarly, the mean Fraction of Startups with Commercialized Products is 1.067, which is well above the ideal benchmark of 0.50, indicating strong market conversion of incubated ventures. The mean Fraction of Startups with Patents Filed/Granted is 0.847, substantially exceeding the ideal value of 0.25, highlighting a high level of innovation and intellectual property generation. Overall, except for marginal underperformance in external funding, the mean values show that Karnataka's BICs outperform the ideal standards in most output dimensions, confirming strong startup outcomes at the state level.

Table 4: Multiple Regression Analysis

Multiple Regression Analysis				
	Co-eff.	P-value	Collinearity Stat.	
			Tolerance	VIF
(Constant)	265.229	0.477	-	-
Incubator Staff to incubated Startup Ratio	-41.944	0.389	0.635	1.575
Fractions of Seats Utilized in the Incubator %	1.797	0.234	0.826	1.210
Acceptance Rate of Incubatees %	3.374	0.283	0.500	2.000
Incubation Services Provided by Incubators	-30.125	0.010	0.367	2.721
Diversity of Funding Resources Accessed by Incubator	1.187	0.000	0.528	1.894
CEO Credential	-14.835	0.587	0.303	3.305
Incubator Responsiveness	13.918	0.506	0.338	2.960
Incubators Active Network Partners	-7.910	0.239	0.380	2.630
Quality of No. of Workshops Events	-0.489	0.955	0.321	3.119
Suite of Services Provided by the Incubators	-22.350	0.536	0.506	1.978
F Stat.	438.084			
Significant Value	0.000			
R Square	0.998			
Adjusted R Square	0.996			
Std. Error of the Estimate	116.939			
Normality-Shapiro-Wilk	0.554			
Heteroskedasticity-Breusch-Pagan Test	0.542			
Autocorrelation-Durbin-Watson	1.314			

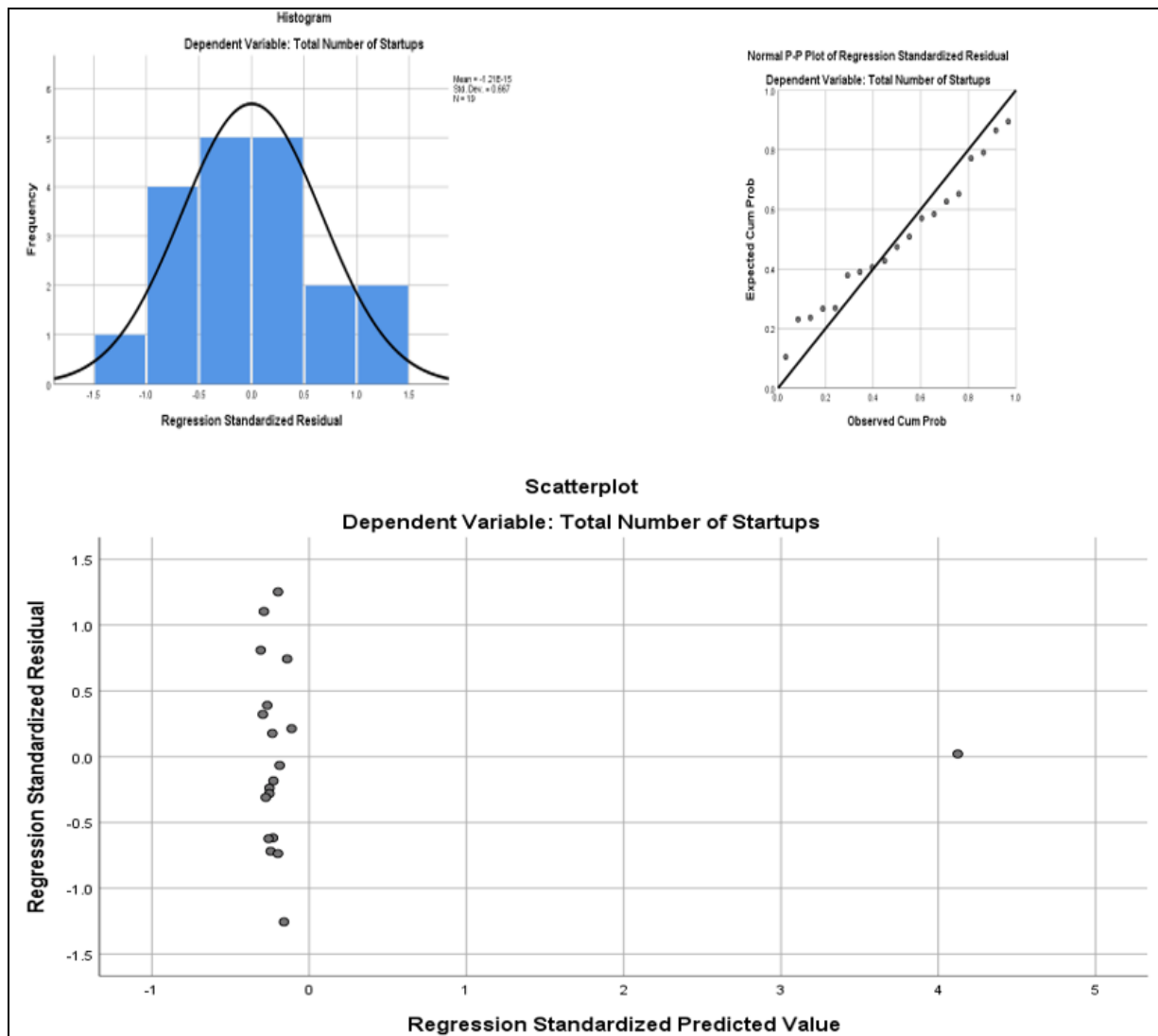


Chart 1: Diagnostic Tests

The multicollinearity diagnostics based on Tolerance and VIF indicate that the regression model is free from multicollinearity issues. All Tolerance values range between 0.303 and 0.826, which are well above the minimum acceptable level of 0.10, while all VIF values lie between 1.210 and 3.305, remaining below the critical threshold of 10 (and even below 5). Hence, the independent variables do not exhibit high intercorrelations, confirming the adequacy and reliability of the regression model.

The multiple regression results indicate that only a limited set of explanatory variables significantly influence startup numbers. Diversity of Funding Resources Accessed by the Incubator has a positive and highly significant impact on the number of startups ($\beta = 1.187$, $p = 0.000$), implying that incubators with access to more diversified funding sources are able to attract and support a larger number of startups. In contrast, Incubation Services Provided by Incubators shows a negative and statistically significant relationship with the number of startups ($\beta = -30.125$, $p = 0.010$), suggesting that an increase in the range of services is associated with a decline in the number of startups, possibly due to higher specialization or stricter selection mechanisms. All other variables, Incubator Staff to Incubated Startup Ratio ($\beta = -41.944$, $p = 0.389$), Fraction of Seats Utilized in the

Incubator ($\beta = 1.797$, $p = 0.234$), Acceptance Rate of Incubatees ($\beta = 3.374$, $p = 0.283$), CEO Credential ($\beta = -14.835$, $p = 0.587$), Incubator Responsiveness ($\beta = 13.918$, $p = 0.506$), Incubators' Active Network Partners ($\beta = -7.910$, $p = 0.239$), Quality of Number of Workshops/Events ($\beta = -0.489$, $p = 0.955$), and Suite of Services Provided by the Incubators ($\beta = -22.350$, $p = 0.536$) are statistically insignificant, as their p-values exceed the 5 percent level. Overall, the results suggest that funding diversity is the strongest driver of startup numbers, while other input and process factors do not exert a statistically significant influence in the model.

The model summary indicates an exceptionally strong overall fit of the regression model explaining the number of startups. The R-square value of 0.998 shows that 99.8 percent of the variation in the number of startups is explained by the selected independent variables, while the adjusted R-square of 0.996 confirms that the model remains highly robust even after accounting for the number of predictors. The F-statistic of 438.084, with a significance value of 0.000, demonstrates that the model is statistically significant as a whole. The standard error of the estimate (116.939) suggests a reasonable level of prediction accuracy given the scale of the dependent variable. Diagnostic tests

further support the validity of the model: the Shapiro–Wilk statistic (0.554) indicates that the residuals are normally distributed, the Breusch–Pagan test value (0.542) confirms the absence of heteroskedasticity, and the Durbin–Watson statistic (1.314) suggests no serious autocorrelation problem. Overall, the model satisfies the key regression assumptions and provides a highly reliable explanation of variations in the number of startups.

Conclusion

The overall analysis of Input, Process, and Output KPIs reveals that Business Incubation Centers (BICs) in Karnataka demonstrate strong performance in outcome-oriented indicators, while moderate gaps exist in input and certain process dimensions. Under Input KPIs, although districts like Bangalore, Dharwad, Mangalore, and Mysuru show strength in infrastructure, services, and funding diversity, the overall state mean indicates limitations in staff–startup ratio, annual incubation capacity, seat utilization, and funding access across several districts. In terms of Process KPIs, Karnataka performs relatively better, with most districts meeting or exceeding ideal benchmarks in governance structure, strategic planning, mentoring systems, compliance mechanisms, and service delivery; however, responsiveness and CEO credentials show moderate variation. Most notably, Output KPIs demonstrate strong performance statewide, with high revenue generation, employment creation, commercialization rates, and patent activity, indicating that incubators are effectively translating resources and processes into tangible startup outcomes. Therefore, while strengthening input capacity and improving uniformity in process efficiency is essential, the overall impact of BICs in Karnataka is positive, particularly in driving startup growth, innovation, and economic contribution.

The multiple regression analysis concludes that the model explaining the number of startups is statistically strong and significant, with a high explanatory power ($R^2 = 0.998$) and overall model significance ($p = 0.000$). Among all independent variables, Diversity of Funding Resources Accessed by Incubators emerges as the only positive and highly significant determinant of startup numbers, indicating that broader funding access directly enhances startup growth. Conversely, Incubation Services Provided by Incubators shows a significant negative relationship, suggesting possible specialization or selective incubation effects. Other input and process variables do not exhibit a statistically significant influence. Diagnostic tests confirm that the model satisfies key regression assumptions, including absence of multicollinearity, heteroskedasticity, and serious autocorrelation. Overall, the findings highlight that funding ecosystem strength is the most critical driver of startup expansion in Karnataka's incubation framework.

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