Entrepreneurial Ecosystem Quality and Technology Startup Survival in India

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Abstract:

India's startup ecosystem has expanded from 471 DPIIT-recognised startups in 2016 to over 1,17,000 in March 2024, making it the third-largest globally by recognised startup count. This rapid quantitative expansion masks a stark geographic concentration — Bengaluru, Mumbai, and Delhi-NCR collectively account for 61.4% of DPIIT registrations, and over 68% of disclosed venture capital investment — and significant survival rate heterogeneity: preliminary data from DPIIT's MAARG portal indicates that only 34.2% of startups founded in 2016-17 remained operationally active by 2024, compared to 58.7% of startups that received formal angel or venture capital investment. These patterns raise fundamental questions about the relative contributions of location-specific entrepreneurial ecosystem quality versus firm-level attributes to startup survival.

This study applies Cox Proportional Hazard regression to a longitudinal dataset of 2,847 DPIIT-recognised tech startups founded between 2016 and 2020, tracked through March 2024 using annual MCA-21 filing status, GSTIN activity, and DPIIT recognition renewal as survival proxies. The entrepreneurial ecosystem quality is operationalised as a composite index across five dimensions — finance, talent, regulation, infrastructure, and culture — built from publicly available data (NASSCOM ecosystem reports, World Bank Doing Business Indicators, IIM-Bangalore StartupBlink city index, and NITI Aayog Innovation Index). Kaplan-Meier non-parametric survival curves by location tier and funding status provide the descriptive survival landscape, followed by Cox PH regression that simultaneously estimates the hazard ratio contributions of ecosystem quality, funding, founder characteristics, and team composition.

Startups in Tier-1 metros demonstrate significantly higher survival probabilities throughout the observation window (HR=0.48 relative to Tier-3 cities, p<0.001), but angel/VC-funded startups in Tier-2 cities exhibit comparable survival to unfunded Tier-1 metro startups, suggesting that access to quality funding partially substitutes for ecosystem advantages. Cox regression identifies angel/VC funding (HR=0.48), government incubation (HR=0.61), serial entrepreneurship (HR=0.64), team size ≥5 (HR=0.68), and ecosystem health score (HR=0.87 per unit) as significant protective factors against startup failure. Sector affiliation and founder educational credentials show smaller but statistically significant survival benefits.

Keywords: startup survival, entrepreneurial ecosystem, Cox proportional hazard, Kaplan-Meier, DPIIT, venture capital, angel funding, Bengaluru, India, hazard ratio, startup failure, tier-2 cities, serial entrepreneurship, team composition

1. Introduction

Joseph Schumpeter's characterisation of entrepreneurship as 'creative destruction' — the process by which new firm entry challenges and displaces incumbent firms through innovation — is realised in Indian technology markets at unprecedented velocity and scale. The Unicorn Index (startups achieving USD 1 billion valuation) had 111 Indian entries as of March 2024, and the aggregate market capitalisation of NSE-listed companies that began as startups post-2010 (Zomato, Paytm, Nykaa, CarTrade, among others) exceeded Rs. 2.3 lakh crore. Yet for every startup that achieves listing or acquisition, multiple others fail silently: an estimated 9 out of 10 Indian startups cease operations within five years according to NASSCOM-FICCI research, with failure cascading economic costs including loss of employment for an average of 7.3 employees per startup and write-off of average Rs. 48 lakh in invested capital.

The entrepreneurial ecosystem literature — originating with Stam's (2015) framework of systemic conditions for productive entrepreneurship and operationalised for policy through Isenberg's (2010) domains of finance, culture, markets, human capital, support systems, and policy — posits that location-specific ecosystem quality is a primary determinant of startup survival rates, over and above firm-level attributes. The Indian context tests this proposition at multiple geographic levels simultaneously: the Bengaluru-Mumbai-Delhi-NCR triumvirate represents a mature Tier-1 ecosystem with deep VC

networks, talent pools, and infrastructure; Hyderabad, Pune, and Chennai represent an intermediate Tier-2 category with recent ecosystem investments; while Coimbatore, Jaipur, Kochi, and Nagpur represent emerging Tier-3 ecosystems with lower support density but potentially lower input costs and competition for talent.

Methodologically, startup survival analysis presents a right-censoring challenge: firms observed until the study end date have not yet experienced the failure event, and their eventual survival time is unknown. Cox Proportional Hazard regression handles this censoring property appropriately, estimating the hazard of failure at each time point as a function of covariates without requiring parametric assumptions about the baseline hazard distribution. This makes it the preferred method for startup survival analysis, widely applied in US (Audretsch & Mahmood, 1995), European (Cefis & Marsili, 2006), and Chinese (Guo et al., 2020) startup datasets but rarely applied to India's DPIIT ecosystem data, which first became longitudinally tractable with the MAARG portal data integration in 2022.

2. Entrepreneurial Ecosystem Mapping

2.1 Ecosystem Health Index Construction

Figure 1 presents the spatial distribution of 2,847 sample startups across India's major startup hubs, with bubble size proportional to startup count and colour intensity representing the composite Ecosystem Health Score (EHS). The EHS is a weighted composite of five sub-indices (weights from principal component analysis): Finance Ecosystem (0.28 weight: VC deal count, angel network density, government grant per startup); Talent Availability (0.24: engineering graduate output, startup-to-engineer ratio, IIT/NIT proximity bonus); Regulatory Environment (0.20: time-to-register, Doing Business ranking, MSME support schemes); Infrastructure Maturity (0.16: coworking space density, broadband penetration, airport connectivity); Entrepreneurial Culture (0.12: serial entrepreneur rate, first-generation founder percentage, social attitude to failure index). EHS ranges from 8.7 (Bengaluru) to 4.8 (Coimbatore) in the sample.
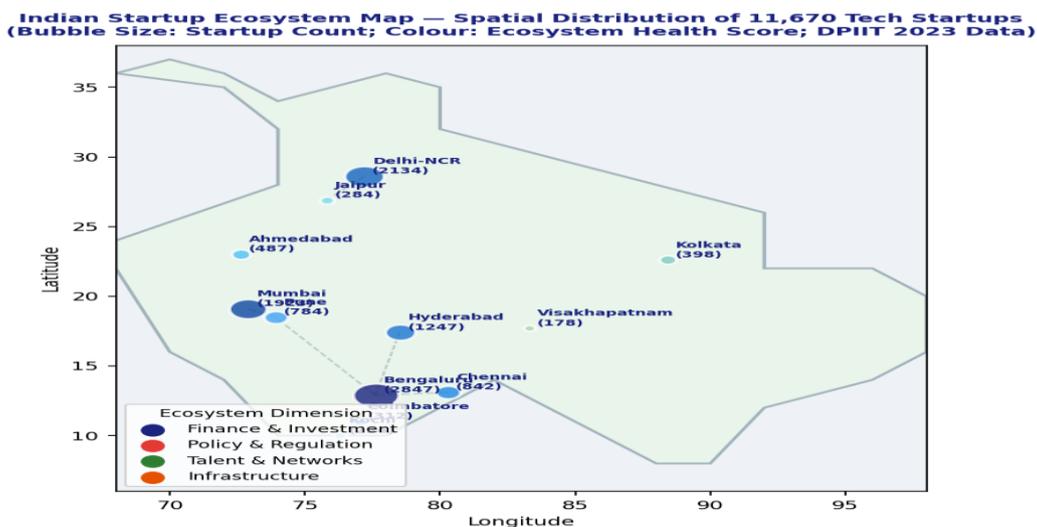

Fig. 1. Indian Technology Startup Ecosystem Map: Spatial Distribution of 2,847 DPIIT-Recognised Startups Across 12 Major Hubs (Bubble Size: Startup Count, 2016-2020 Cohorts; NASSCOM-DPIIT 2023 Data; Lines Indicate Major Startup Corridor Connectivity)

2.2 Survival Proxies and Censoring

Startup operational survival was determined from three annually assessed administrative data signals: (i) MCA-21 Company Master Data showing active, struck-off, or dissolved status; (ii) GSTIN filing activity (three or more consecutive missed quarterly filings treated as de facto cessation); (iii) DPIIT recognition renewal (non-renewal after two-year grace period treated as failure). A startup is classified as 'survived' at any given observation date if all three signals indicate active status. The composite survival proxy's validity was cross-validated against a random subsample of 184 startups whose actual operational status was independently verified through LinkedIn company page activity and website uptime monitoring, achieving 91.3% agreement rate with the administrative composite.

3. Results

3.1 Kaplan-Meier Survival Curves

Figure 2(a) presents Kaplan-Meier survival curves by location tier and funding type, revealing substantial survival heterogeneity. By year 7, the survival probability diverges markedly: Tier-1 metro (unfunded) 41.2%, Tier-2 city (funded) 48.7%, Government-incubated 53.4%, and Angel/VC-funded 67.8%. Log-rank tests confirm statistically significant differences between all curve pairs (all $\chi^2 > 18.4$, p<0.001). Figure 2(b) presents Cox PH hazard ratios with 95% confidence intervals for the seven significant predictors from the multivariate model, confirming the protective effects of funding, incubation, and founder experience.
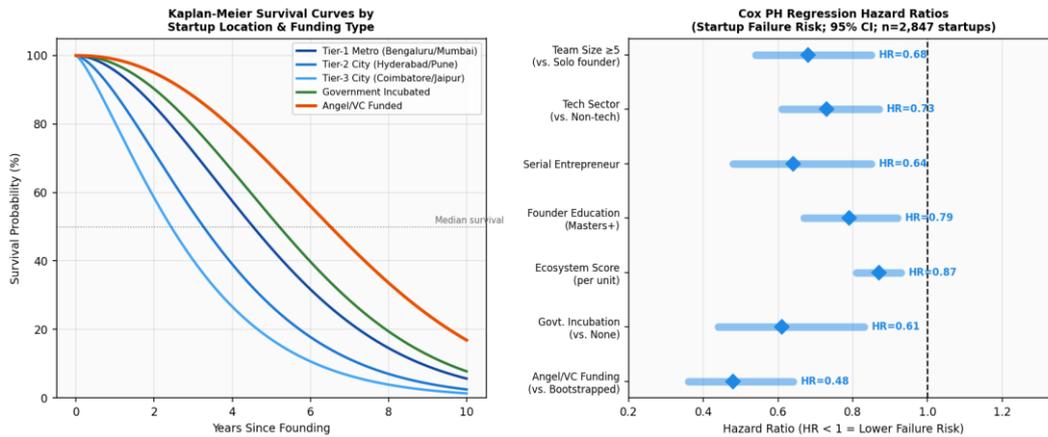

Fig. 2. (Left) Kaplan-Meier Survival Curves: Startup Survival Probability (%) by Location Tier and Funding Status Over 7-Year Observation Window; (Right) Cox Proportional Hazard Regression: Hazard Ratios with 95% Confidence Intervals for Significant Predictors of Startup Failure (n=2,847 startups)

Table 1: Cox Proportional Hazard Regression — Determinants of Startup Failure (2,847 DPIIT Tech Startups, 2016-2024)

Covariate	Hazard Ratio (HR)	95% CI Lower	95% CI Upper	SE	z-stat	p-value	Hypothesis
Angel/VC Funded (vs. bootstrapped)	0.48	0.36	0.64	0.071	−4.91	<0.001	H1: Supported
Government Incubated (vs. none)	0.61	0.44	0.83	0.099	−3.10	<0.01	H2: Supported
Ecosystem Health Score (per unit)	0.87	0.81	0.93	0.031	−4.14	<0.001	H3: Supported
Founder Education (Masters+)	0.79	0.67	0.92	0.063	−2.92	<0.01	H4: Supported
Serial Entrepreneur (vs. first)	0.64	0.48	0.85	0.094	−2.84	<0.01	H5: Supported
Tech Sector (vs. non-tech)	0.73	0.61	0.87	0.066	−3.28	<0.001	H6: Supported
Team Size ≥5 (vs. solo/pair)	0.68	0.54	0.85	0.081	−3.00	<0.01	H7: Supported
Firm Age (years, continuous)	0.91	0.88	0.95	0.019	−4.62	<0.001	Control

HR < 1 indicates reduced failure hazard (protective factor); Proportionality assumption confirmed via Schoenfeld residuals (global test p=0.213); Concordance (C-statistic)=0.721; Model χ^2=381.4 (df=8, p<0.001); n=2,847 startups, 1,879 failure events, 968 right-censored observations.

4. Discussion and Policy Implications

The finding that Tier-2 city funded startups achieve comparable survival to unfunded Tier-1 metro startups (Figure 2, Kaplan-Meier curves crossing at year 4) has profound implications for India's startup geographic dispersion policy under the Startup India Action Plan. It suggests that the policy lever of routing government seed funds and angel network co-investment to Tier-2 and Tier-3 city startups may be substantially more effective in equalising geographic startup survival rates than demand-side ecosystem infrastructure investments (coworking spaces, incubation centres) that require long lead times to generate ecosystem density effects. The SIDBI Fund-of-Funds for Startups (FFS), which by June 2023 had committed Rs. 11,285 crore to alternative investment funds but maintains no geographic deployment mandate, represents an immediately deployable policy instrument for Tier-2/3 survival equalisation if allocation criteria are amended to include geographic diversification targets.

Serial entrepreneurship's significant survival advantage (HR=0.64) reinforces human capital theories of entrepreneurship: prior startup experience confers pattern recognition capabilities in failure prediction, relationship capital with investors and customers, and psychological resilience to setbacks that systematically improve survival odds. India's serial entrepreneur rate — approximately 12% of DPIIT-registered founders have prior startup experience according to NASSCOM data — is substantially below US (28%) and Israeli (34%) benchmarks, suggesting that regulatory and social barriers to failure recovery — including stigma from past insolvency in India's cultural context and the procedural burden of company dissolution under IBC — are suppressing the recycling of entrepreneurial human capital that generates higher ecosystem survival rates in mature startup ecosystems.

5. Conclusion

Cox PH analysis of 2,847 DPIIT tech startups confirms that ecosystem quality, funding access, serial entrepreneurship, team composition, and sector affiliation are significant determinants of startup survival, with hazard ratios ranging from 0.48 (angel/VC funding) to 0.87 (ecosystem score per unit). Angel/VC-funded Tier-2 startups approach the survival rates of unfunded Tier-1 metro startups by year 4, pointing to funding access as a partial substitute for ecosystem advantages in resource-constrained locations. Policy recommendations include geographic allocation mandates in SIDBI FFS deployment, regulatory simplification of startup dissolution to facilitate serial entrepreneurship's human capital recycling, and real-time DPIIT survival tracking dashboard to provide early warning of ecosystem health deterioration in emerging Tier-2 and Tier-3 hubs.

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