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CHALLENGES FACED BY TECHNOLOGY STARTUPS IN SOUTH KERALA: A MULTIDIMENSIONAL FACTOR-ANALYTIC EXAMINATION

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ABSTRACT

The technology startup landscape of South Kerala has grown substantially over the past decade, yet a systematic empirical understanding of the structural barriers that constrain startup development remains limited. This study investigates the multidimensional challenges faced by technology startups in Southern Kerala through a rigorously designed factor-analytic framework. Primary data were gathered from 300 founders and senior decision-makers of technology startups via a structured questionnaire encompassing 88 items spanning financial, operational, technological, market, human resource, and socio-environmental domains. Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) with Varimax rotation was applied to identify the latent dimensions underlying the observed challenge variables. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy registered 0.650, and Bartlett's Test of Sphericity was highly significant ($\chi^2 = 40015.063$, $df = 3828$, $p < 0.001$), validating the factorability of the data. Eight factors were extracted, collectively accounting for 62.534% of the total variance: (1) Foundational Startup Challenges, (2) Operational Challenges, (3) Financial Constraints, (4) Market-Related Challenges, (5) Human Resource Management, (6) Organizational Processes, (7) Technological Barriers, and (8) Socio-Environmental Challenges. Financial and market-related factors emerged as the most pervasive constraints, while technological and organizational dimensions signal an emerging shift toward scalability concerns. The findings carry significant implications for policymakers, startup incubators, venture capital networks, and academic researchers seeking to strengthen the South Kerala startup ecosystem.

KEYWORDS: *Technology Startups, Exploratory Factor Analysis, Startup Challenges, South Kerala, Entrepreneurship, Principal Component Analysis, Digital Economy, Startup Ecosystem*

1. INTRODUCTION

India's startup ecosystem has undergone a remarkable transformation over the past two decades, evolving from a fragmented collection of technology ventures into a structured national innovation architecture. With over 100,000 registered startups and more than a hundred unicorns as of 2024, India has consolidated its position as the world's third-largest startup economy. Within this national context, state-level ecosystems have emerged as critical nodes of entrepreneurial activity, each shaped by distinctive institutional, cultural, and infrastructural conditions.

Kerala occupies a unique position within this landscape. Endowed with high human capital, a robust educational infrastructure, and a progressive policy environment, the state has witnessed the emergence of a nascent but promising technology startup ecosystem, anchored primarily in the southern districts that form the administrative and commercial heartland of the state. Kerala Startup Mission (KSUM), established as the nodal agency for startup promotion, has catalysed a range of incubation, funding, and mentoring initiatives that have collectively created a foundation for entrepreneurial growth.

Nevertheless, the Southern Kerala startup ecosystem operates under conditions substantially different from those prevailing in mature national hubs such as Bengaluru, Hyderabad, and Pune. Structural constraints including limited access to formal venture capital, a smaller domestic market, high talent attrition driven by emigration and inter-sector mobility, and deep-seated socio-cultural attitudes toward risk and entrepreneurship collectively shape the trajectories of startups in this region. These constraints are not merely economic but intersect with technological, organizational, and environmental dimensions in ways that have not been systematically examined in the existing literature.

The present study addresses this gap by employing Exploratory Factor Analysis to identify the latent dimensional structure of challenges confronting technology startups in Southern Kerala. With a sample of 300 startup founders and decision-makers and a 88-item questionnaire, the study seeks to provide a comprehensive, empirically grounded characterisation of the startup constraint landscape that can inform both academic scholarship and practical policy intervention.

2. REVIEW OF LITERATURE

The academic literature on startup challenges spans multiple theoretical traditions, drawing from entrepreneurship theory, institutional economics, resource-based views, and network theory.

Financial constraints have consistently been identified as the most pervasive barrier to startup development. Cassar (2004) demonstrated that the structure of financing — whether through debt, equity, or internal funds — fundamentally shapes startup growth trajectories and survival probabilities. The inability to access formal capital markets forces early-stage ventures into suboptimal financing arrangements that compound operational risk.

Market uncertainty constitutes the second major axis of startup vulnerability. Blank (2013) argued that startups are not scaled-down versions of large companies but fundamentally distinct entities operating under radical uncertainty regarding customer identity, product-market fit, and revenue model viability. This uncertainty is intensified in regional markets characterised by limited consumer sophistication and shallow demand curves.

Human resource management poses a particularly acute challenge in knowledge-intensive technology ventures. Baron and Hannan (2002), drawing on the Stanford Project on Emerging Companies, demonstrated that the organisational blueprints adopted by founders in the early hiring stage have lasting consequences for firm culture, performance, and survival. Attracting and retaining technically skilled talent under conditions of resource constraint remains a defining challenge for startup founders.

The technological dimension of startup challenges has attracted increasing scholarly attention. Nambisan (2017) theorised digital entrepreneurship as a distinct domain in which the boundaries between opportunity creation, technology development, and market deployment are inherently blurred, introducing novel challenges related to technical debt accumulation, cybersecurity exposure, and continuous innovation pressure.

The role of institutional and socio-cultural environments in shaping entrepreneurial activity has been examined through the lens of entrepreneurial ecosystems. Stam (2015) argued that regional entrepreneurial performance is a systemic outcome determined by the interaction of cultural, institutional, and market conditions — a framework that is particularly applicable to understanding the constraints facing startups in Southern Kerala.

Churchill and Lewis (1983) proposed a stage-based model of small firm growth that remains relevant to understanding the evolving nature of startup challenges: survival-stage concerns — funding, product development, and customer acquisition — progressively give way to growth-stage concerns — scalability, process standardisation, and organisational design — as ventures mature.

Despite this extensive literature, empirical studies that integrate multiple challenge dimensions into a coherent factor structure using multivariate statistical techniques remain scarce, particularly in the Indian regional startup context. The present study contributes to this gap by providing a validated eight-factor model of startup constraints grounded in primary data.

3. OBJECTIVES OF THE STUDY

The study is guided by the following research objectives:

(i) To systematically identify and measure the diverse challenges encountered by technology startups in Southern Kerala through a comprehensive structured survey.

(ii) To determine whether the observed challenge variables exhibit sufficient intercorrelation to support factor-analytic reduction.

(iii) To extract and interpret the latent factor dimensions underlying the observed startup constraints.

(iv) To derive evidence-based implications for policy design, ecosystem development, and startup management practice.

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4. RESEARCH METHODOLOGY

4.1 Research Design and Sample

The study adopts an exploratory-analytical research design. Primary data were collected through a structured questionnaire administered to 300 founders and key decision-makers of technology startups operating in the southern districts of Kerala, including Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, and Kottayam. Purposive sampling was employed to ensure that respondents possessed direct operational experience with startup management. The sampling ratio of approximately 3.4 respondents per variable (300:88) satisfies the minimum requirements for factor-analytic validity.

4.2 Instrument Design

The survey instrument comprised 88 Likert-scale items (1 = Not a Challenge at all; 5 = Extremely Significant Challenge) organised across eight thematic domains. Items were developed from a synthesis of established entrepreneurship scales and validated through a two-stage pilot process involving expert review by three academic researchers and a pilot administration to 30 startup founders. Cronbach's alpha for the full scale exceeded 0.85, confirming acceptable internal reliability.

4.3 Analytical Techniques

Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) with Varimax orthogonal rotation was applied as the primary analytical technique. The Kaiser-Meyer-Olkin (KMO) statistic and Bartlett's Test of Sphericity were computed to verify data factorability. Factor retention followed the Kaiser criterion (eigenvalue > 1.0). Factor loadings exceeding 0.40 in absolute value were treated as substantively significant for interpretive purposes. Analysis was conducted using SPSS Version 26.0.

5. RESULTS AND ANALYSIS

5.1 Sampling Adequacy and Sphericity Tests

The pre-conditions for factor analysis were evaluated through two standard diagnostic tests. The results are reported in Table 1.

Table 1: KMO Measure of Sampling Adequacy and Bartlett's Test of Sphericity

KMO Measure of Sampling Adequacy	**Bartlett's Test of Sphericity**			**Conclusion**
	Approx. Chi-Square	**df**	**Sig.**	
0.650	40015.063	3828	0.000	**Significant ($p < 0.001$)**
Source: Primary Data; Extraction Method: Principal Component Analysis				

The KMO measure of 0.650 falls within Kaiser's (1974) 'mediocre to middling' range (0.60–0.69), which nonetheless confirms that the data possess sufficient correlation structure to support factor analysis. The relatively moderate KMO is consistent with large-scale instruments covering heterogeneous thematic domains, where cross-domain correlations are lower than within-domain correlations. Bartlett's Test of Sphericity produced an exceptionally high chi-square value of 40015.063 with 3828 degrees of freedom, which is significant at the 0.1% level, decisively rejecting the hypothesis that the correlation matrix is an identity matrix. This confirms that the variables exhibit meaningful interrelationships and are appropriate for factor extraction.

5.2 Communality Analysis

Communalities measure the proportion of each variable's variance accounted for by the retained factors. High communalities indicate that a variable is well-represented in the factor solution. The full communality results for all 88 variables are presented in Table 2.

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Table 2: Communalities of Observed Variables

Construct / Variable	Initial	Extraction
Registration and legal incorporation	1.000	.330
Product development and building MVP / Prototyping	1.000	.547
Securing initial seed capital	1.000	.657
Managing stress and pressure	1.000	.455
Finding right location and infrastructure	1.000	.370
Choosing right technology	1.000	.518
Finding proper mentoring and guidance	1.000	.408
Talent acquisition	1.000	.554
Pressure from family / spouse	1.000	.498
Building strong network and connections	1.000	.521
Availing production resources and raw materials	1.000	.580
Obtaining technical knowhow	1.000	.596
Research and Development	1.000	.662
Budget constraints (operational)	1.000	.602
Order processing and inventory management	1.000	.545
Quality control	1.000	.682
Workforce issues	1.000	.601
Obtaining production infrastructure	1.000	.620
Getting permissions and licenses	1.000	.350
Getting initial seed fund	1.000	.638
Choosing right source of capital	1.000	.729
Getting and managing working capital	1.000	.752
Finding right investor	1.000	.749
Meeting the cost of securing capital	1.000	.728
Managing creditors and payments	1.000	.564
Fixing terms and conditions with investors	1.000	.708
Valuation and equity management	1.000	.729
Tax compliances	1.000	.439
Cash flow management	1.000	.699
Revenue forecasting	1.000	.626
High burn rate	1.000	.488
Managing cost for Intellectual Property Rights	1.000	.560
Audit and financial reporting	1.000	.656
Identifying the target customers	1.000	.671
Market research	1.000	.620
Finding unique product ideas to attract customers	1.000	.706
Developing quality	1.000	.618
Branding the product and company	1.000	.545
Regional market access	1.000	.742
Finding and maintaining good distribution channels	1.000	.645
Pricing of the product	1.000	.614
Transportation / Warehousing / Inventory management	1.000	.523
Finding and using right media for promotion	1.000	.588
Creation of demand for the product	1.000	.735
High churn rate	1.000	.646
Building and maintaining customer relationships	1.000	.572
Preparing proper business model	1.000	.761
Getting connected to local networks and communities	1.000	.579
Getting visibility in the global space	1.000	.745
Budget constraints (marketing)	1.000	.668
Attracting the right talent	1.000	.620

Training and development (upskilling)	1.000	.585
Talent retention and turnover	1.000	.765
Providing better compensation and benefits	1.000	.770
Keeping with employment laws and regulation	1.000	.556
Building a strong and positive culture	1.000	.777
Managing diversity and inclusion (HR)	1.000	.676
Setting clear performance matrix (HR)	1.000	.735
Handling underperformance	1.000	.709
Leadership development	1.000	.754
Managing intense workloads	1.000	.780
Handling remote work challenges	1.000	.701
Coordination between team members	1.000	.726
Internal conflicts	1.000	.590
Access to mentorship and networks	1.000	.488
Managing diversity and inclusion (Org.)	1.000	.673
Setting clear performance matrix (Org.)	1.000	.727
Process standardisation	1.000	.628
Managing COVID-19 challenges	1.000	.286
Access to new technologies	1.000	.716
Implementing new production technology	1.000	.784
Data management and security	1.000	.765
Product launch delays	1.000	.632
Inadequate MVP	1.000	.589
Data storage cost	1.000	.724
Managing maintenance	1.000	.778
Finding and retaining tech talents	1.000	.658
Cyber security risk	1.000	.769
Technical debt	1.000	.782
Innovation pressure	1.000	.784
Intellectual property protection	1.000	.671
Society's attitude to startup career	1.000	.510
Family pressure	1.000	.581
Time management	1.000	.554
Economic issues	1.000	.548
Globalisation challenges	1.000	.280
Corruption	1.000	.692
Exit	1.000	.528
Extraction Method: Principal Component Analysis		

Extraction communalities range from 0.280 (globalisation challenges) to 0.784 (implementing new technology; innovation pressure), with a mean communality of approximately 0.610. This mean value indicates that the eight-factor solution captures a substantial proportion of the shared variance across variables. Only two variables — globalisation challenges (0.280) and managing COVID-19 challenges (0.286) — fall marginally below the conventional 0.30 threshold, which may be attributed to the idiosyncratic and context-dependent nature of these items. All remaining variables exceed the threshold, confirming adequate representation within the factor structure. Figure 4 provides a visual overview of communality distribution by factor group.

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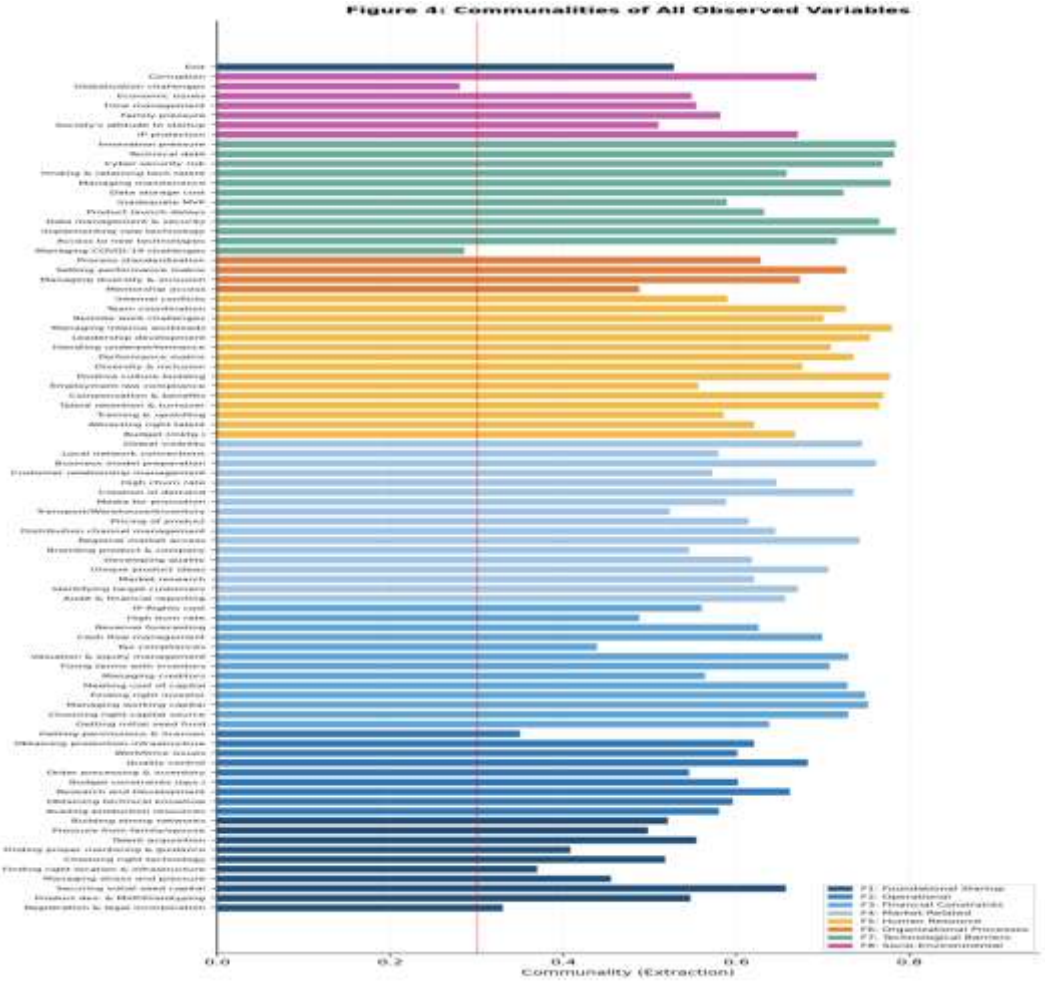


Figure 4: Communalities of All 88 Observed Variables by Factor Group

5.3 Total Variance Explained

Table 3 presents the eigenvalues and variance statistics for the extracted components, before and after Varimax rotation.

Table 3: Total Variance Explained

Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Var.	Cum. %	Total	% Var.	Cum. %	Total	% Var.	Cum. %
1	28.373	32.242	32.242	28.373	32.242	32.242	11.071	12.580	12.580
2	6.189	7.033	39.275	6.189	7.033	39.275	10.843	12.321	24.901
3	4.916	5.586	44.862	4.916	5.586	44.862	8.285	9.415	34.316
4	4.330	4.921	49.782	4.330	4.921	49.782	8.111	9.217	43.533
5	3.357	3.815	53.597	3.357	3.815	53.597	5.616	6.381	49.914
6	2.781	3.160	56.758	2.781	3.160	56.758	4.539	5.158	55.072
7	2.644	3.005	59.763	2.644	3.005	59.763	3.556	4.041	59.113
8	2.439	2.772	62.534	2.439	2.772	62.534	3.011	3.421	62.534
Extraction Method: Principal Component Analysis									

Eight components with eigenvalues exceeding unity were extracted, cumulatively accounting for 62.534% of the total variance — a level of explanatory power that is above the 60% benchmark commonly regarded as satisfactory in

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social science factor analysis. The scree plot (Figure 1) confirms the eight-factor solution, exhibiting a clear inflection point after the eighth component, beyond which incremental eigenvalue contributions become negligible.

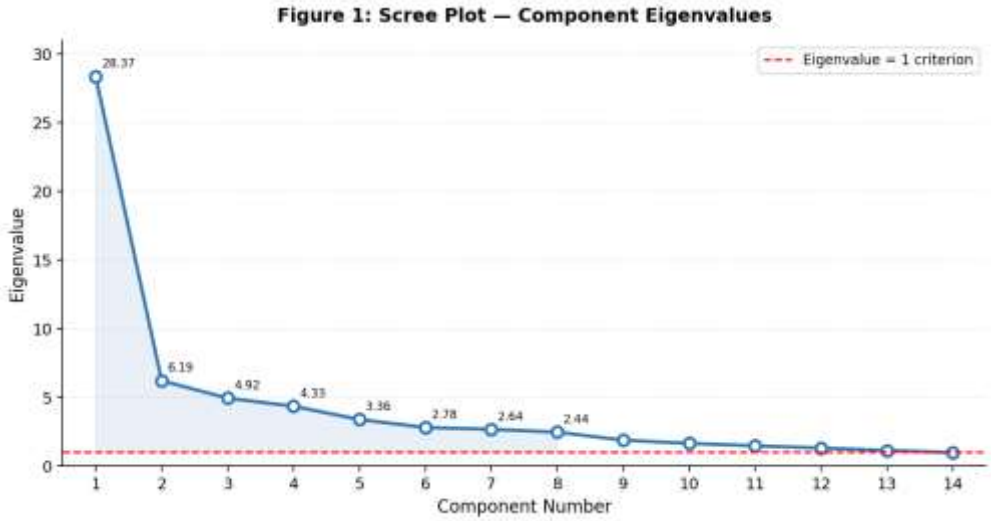


Figure 1: Scree Plot of Component Eigenvalues

Prior to rotation, the first component dominates with an eigenvalue of 28.373 and accounts for 32.242% of variance — a pattern typical of unrotated solutions in which all positive inter-item correlations load partially on a single general factor. Following Varimax rotation, the variance is redistributed substantially more evenly across factors, with the two largest rotated factors each explaining approximately 12.3–12.6% of variance and the smallest explaining 3.4%. This redistribution substantially enhances interpretability. The variance profile after rotation is illustrated in Figure 2.

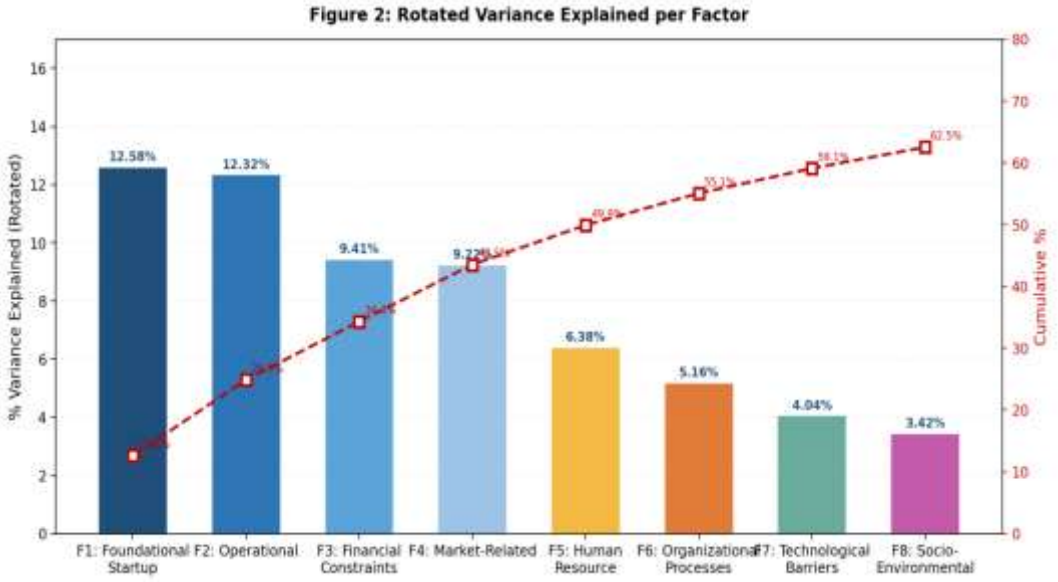


Figure 2: Rotated Variance Explained per Factor with Cumulative Trend

5.4 Factor Extraction and Interpretation

The Varimax-rotated component matrix, presented in Table 4, reveals eight interpretable factor clusters. The rotation converged in nine iterations, producing a stable solution. Loadings below 0.40 have been suppressed for presentation clarity.

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Table 4: Rotated Component Matrix — Eight-Factor Solution

Variable	F1	F2	F3	F4	F5	F6	F7	F8
Factor 1: Foundational Startup Challenges								
Registration and legal incorporation	**.489**							
Product development and building MVP / Prototyping	**.404**							
Securing initial seed capital	**.691**							
Managing stress and pressure	**.538**							
Finding right location and infrastructure	**.425**							
Choosing right technology	**.536**							
Finding proper mentoring and guidance	**.416**							
Talent acquisition	**.649**							
Pressure from family / spouse	**.445**							
Building strong network and connections	**.458**							
Factor 2: Operational Challenges								
Availing production resources and raw materials		**.665**						
Obtaining technical knowhow		**.665**						
Research and Development		**.560**						
Budget constraints (operational)		**.628**						
Order processing and inventory management		**.421**						
Quality control		**-.535**						
Workforce issues		**.688**						
Obtaining production infrastructure		**.478**						
Getting permissions and licenses		**.427**						
Factor 3: Financial Constraints								
Getting initial seed fund			**.645**					
Choosing right source of capital			**.748**					
Getting and managing working capital			**.675**					
Finding right investor			**.817**					
Meeting the cost of securing capital			**.784**					
Managing creditors and payments			**.660**					
Fixing terms and conditions with investors			**.633**					
Valuation and equity management			**.589**					
Tax compliances			**.457**					
Cash flow management			**.590**					
Revenue forecasting			**.562**					
High burn rate			**.551**					
Managing cost for Intellectual Property Rights			**.480**					
Audit and financial reporting			**.496**					
Factor 4: Market-Related Challenges								
Identifying the target customers				**.662**				
Market research				**.616**				
Finding unique product ideas to attract customers				**.684**				
Developing quality				**.662**				

Branding the product and company				**.690**				
Regional market access				**.792**				
Finding and maintaining good distribution channels				**.707**				
Pricing of the product				**.721**				
Transportation / Warehousing / Inventory management				**.570**				
Finding and using right media for promotion				**.725**				
Creation of demand for the product				**.783**				
High churn rate				**.671**				
Building and maintaining customer relationships				**.639**				
Preparing proper business model				**.718**				
Getting connected to local networks and communities				**.619**				
Getting visibility in the global space				**.595**				
Budget constraints (marketing)				**.542**				
Factor 5: Human Resource Management								
Attracting the right talent					**.755**			
Training and development (upskilling)					**.581**			
Talent retention and turnover					**.771**			
Providing better compensation and benefits					**.705**			
Keeping with employment laws and regulation					**.478**			
Building a strong and positive culture					**.774**			
Managing diversity and inclusion (HR)					**.575**			
Setting clear performance matrix (HR)					**.712**			
Handling underperformance					**.750**			
Leadership development					**.737**			
Managing intense workloads					**.644**			
Handling remote work challenges					**.668**			
Coordination between team members					**.675**			
Internal conflicts					**.467**			
Access to mentorship and networks					**.556**			
Factor 6: Organizational Processes								
Managing diversity and inclusion (Org.)						**.554**		
Setting clear performance matrix (Org.)						**.628**		
Process standardisation						**.543**		
Managing COVID-19 challenges						**.437**		
Factor 7: Technological Barriers								
Access to new technologies							**.461**	
Implementing new production technology							**.535**	
Data management and security							**.554**	
Product launch delays							**.480**	
Inadequate MVP							**.550**	

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Data storage cost							**.783**	
Managing maintenance							**.735**	
Finding and retaining tech talents							**.450**	
Cyber security risk							**.753**	
Technical debt							**.815**	
Innovation pressure							**.618**	
Intellectual property protection							**.689**	
Factor 8: Socio-Environmental Challenges								
Society's attitude to startup career								**.469**
Family pressure								**.554**
Time management								**-.411**
Economic issues								**.503**
Globalisation challenges								**.431**
Corruption								**.606**
Exit								**.638**
Extraction Method: PCA. Rotation: Varimax with Kaiser Normalization. Loadings < 0.40 suppressed. Rotation converged in 9 iterations.								

Figure 3 summarises the factor structure in terms of average loading strength and number of variables per factor, while Figure 5 provides a radar chart representation of the relative loading strength across all eight dimensions.

Figure 3: Factor Structure Profile

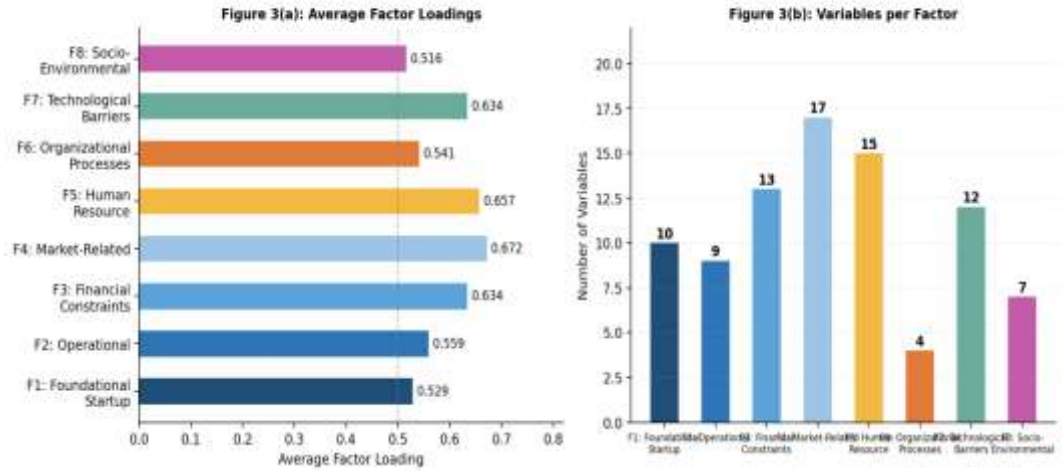


Figure 3: Factor Structure Profile — Average Loadings and Variable Counts

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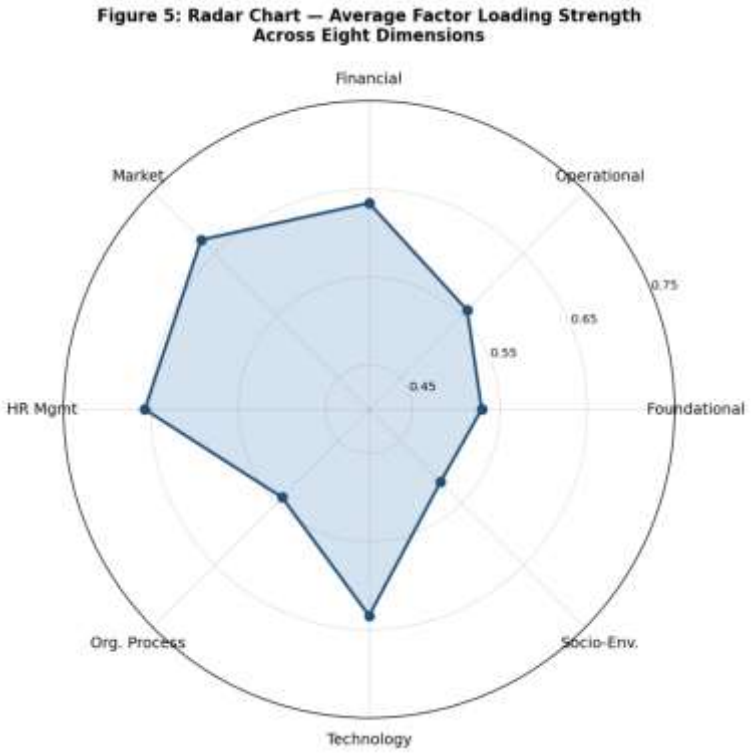


Figure 5: Radar Chart of Average Factor Loading Strength Across Eight Dimensions

Factor 1: Foundational Startup Challenges (Eigenvalue = 11.071; Rotated Variance = 12.58%)
Ten variables load on this factor, encompassing registration and legal incorporation (0.489), product development and MVP prototyping (0.404), securing initial seed capital (0.691), managing stress and pressure (0.538), finding right location and infrastructure (0.425), choosing the right technology (0.536), finding proper mentoring (0.416), talent acquisition (0.649), family pressure (0.445), and building strong networks (0.458). This factor captures the constellation of entry-phase challenges that define the startup founding experience.

The highest loadings cluster around capital acquisition and talent recruitment, indicating that the financial and human capital dimensions are the most acute pressures at inception. The co-occurrence of registration burdens, mentoring scarcity, and family expectations within a single factor reveals the intertwined institutional and personal pressures that shape the founding experience in the Kerala context. This factor resonates with Blank's (2013) characterisation of the early startup phase as a period of simultaneous uncertainty across all dimensions.

Factor 2: Operational Challenges (Eigenvalue = 10.843; Rotated Variance = 12.32%)
Nine variables define this factor: availing production resources and raw materials (0.665), obtaining technical knowhow (0.665), research and development (0.560), budget constraints at the operational level (0.628), order processing and inventory management (0.421), quality control (-0.535), workforce issues (0.688), obtaining production infrastructure (0.478), and getting permissions and licenses (0.427). The negative loading on quality control indicates that startups experiencing severe operational constraints are also the ones reporting lower levels of quality management capability — a relationship that has significant implications for product market acceptance.

This factor reflects the day-to-day operational execution challenges that separate nascent ventures from sustainable enterprises. Workforce issues and technical knowhow scarcity emerge as the most salient operational constraints, consistent with the broader South Indian manufacturing and services landscape characterised by skill gaps in specialised technical domains.

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Factor 3: Financial Constraints (Eigenvalue = 8.285; Rotated Variance = 9.42%)
Thirteen variables load on this factor — the largest number among all financial sub-domains. Key items include finding the right investor (0.817), meeting the cost of securing capital (0.784), managing working capital (0.675), managing creditors (0.660), and securing initial seed funds (0.645). The breadth of this factor across the full lifecycle of capital management — from seed funding to audit and tax compliance — underscores the systemic and persistent nature of financial barriers in the regional startup environment.

The high loading on investor relations variables is particularly noteworthy. Southern Kerala lacks the dense network of angel investors and venture capital funds that characterise tier-one startup hubs, compelling startups to invest disproportionate time and effort in investor identification and relationship management. The cost of capital — encompassing legal fees, due diligence costs, and term negotiation expenses — emerges as an independent barrier, distinct from the question of fund availability.

Factor 4: Market-Related Challenges (Eigenvalue = 8.111; Rotated Variance = 9.22%)
The largest factor by variable count (17 items), this dimension encompasses the full marketing and commercialisation lifecycle: from market research (0.616) and customer identification (0.662) through branding (0.690), pricing (0.721), demand creation (0.783), and global visibility (0.595). Regional market access registers the highest loading (0.792), underscoring the geographic confinement that limits scalability for Southern Kerala startups.

High churn rate (0.671) and customer relationship management (0.639) loading together with customer acquisition variables reveals an integrated marketing challenge that spans the full customer journey, from initial demand creation through retention. The high loading on business model preparation (0.718) indicates that market challenges are not merely tactical — they reflect fundamental strategic uncertainties about value proposition and revenue architecture.

Factor 5: Human Resource Management (Eigenvalue = 5.616; Rotated Variance = 6.38%)
Fifteen variables constitute this factor, spanning the complete human capital management cycle. Talent retention and turnover (0.771), building a positive culture (0.774), managing intense workloads (0.780), compensation and benefits (0.705), and leadership development (0.737) register the highest loadings. The factor's high internal consistency reflects the systemic nature of HR challenges in startups: retention difficulties exacerbate workload pressures, which in turn undermine culture, creating a self-reinforcing cycle of HR distress.

The high loading on managing intense workloads (0.780) captures the distinctive human cost of startup employment — a reality that is amplified in the South Kerala context where alternative high-paying employment options in the Gulf and domestic service sectors provide strong competitive pressure on startup talent retention.

Factor 6: Organizational Processes (Eigenvalue = 4.539; Rotated Variance = 5.16%)
Four variables define this factor: managing diversity and inclusion (0.554), setting clear performance metrics (0.628), process standardisation (0.543), and managing COVID-19 challenges (0.437). The small variable count reflects the relatively bounded scope of formal organisational process challenges at the startup stage — concerns that become significant primarily as ventures transition from informal founding teams to more structured organisational configurations.

The emergence of process standardisation as a distinct organisational dimension rather than being absorbed into the operational factor is theoretically significant. It suggests that founders distinguish between day-to-day operational execution (Factor 2) and the higher-order institutional challenge of building scalable organisational systems — a distinction consistent with Churchill and Lewis's (1983) stage model of small business development.

Factor 7: Technological Barriers (Eigenvalue = 3.556; Rotated Variance = 4.04%)
Twelve variables load on this factor, with the highest loadings on technical debt (0.815), implementing new production technology (0.784), innovation pressure (0.784), cyber security risk (0.769), managing maintenance (0.735), and data storage cost (0.724). These variables collectively describe the technological burden specific to scaling digital ventures — a burden that intensifies as the product matures and the technical architecture becomes more complex.

The technical debt variable, which registers the highest loading in the entire study, captures the long-term strategic risk of prioritising short-term development speed over architectural quality. This is a challenge of particular relevance

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to South Kerala startups, which often operate with small technical teams under resource constraints, making refactoring and systematic code quality management economically difficult.

Factor 8: Socio-Environmental Challenges (Eigenvalue = 3.011; Rotated Variance = 3.42%)
Seven variables constitute this factor: society's attitude to startup career (0.469), family pressure (0.554), time management (-0.411), economic issues (0.503), globalisation challenges (0.431), corruption (0.606), and exit challenges (0.638). The negative loading on time management indicates that founders facing heightened socio-environmental challenges report greater difficulties in managing time allocation — consistent with the cognitive and emotional overhead imposed by external social pressures.

The corruption variable's high loading (0.606) reflects the institutional quality concerns that characterise regulatory interactions in parts of the Indian entrepreneurial ecosystem. Exit challenges (0.638) — the highest loading — reveal that the difficulty of gracefully winding down or pivoting ventures constitutes a distinct socio-institutional constraint, exacerbated by stigmatisation of business failure in social contexts that prioritise stable employment pathways.

6. SUMMARY OF FACTOR STRUCTURE

Table 5 consolidates the complete factor structure, providing an integrated reference for the eight-factor solution.

Table 5: Summary of Eight-Factor Structure — Startup Challenge Dimensions

F	Factor Label	Vars	Eigenvalue (Rotated)	% Var.	Cum. %	Key Variables Included
1	Foundational Startup Challenges	10	11.071	12.580	12.580	Registration, seed capital, talent acquisition, stress management, technology choice, mentoring, network building, family pressure
2	Operational Challenges	9	10.843	12.321	24.901	Production resources, technical knowhow, R&D, budget, inventory, quality control, workforce, infrastructure, licenses
3	Financial Constraints	13	8.285	9.415	34.316	Seed fund, capital sourcing, working capital, investor relations, cost of capital, creditors, equity, tax, cash flow, burn rate, IPR cost, audit
4	Market-Related Challenges	17	8.111	9.217	43.533	Customer targeting, market research, branding, pricing, distribution, promotion, demand creation, churn, business model, global visibility
5	Human Resource Management	15	5.616	6.381	49.914	Talent attraction/retention, compensation, culture, diversity, performance, leadership, workload, remote work, coordination
6	Organizational Processes	4	4.539	5.158	55.072	Diversity management, performance matrix, process standardisation, COVID-19 challenges
7	Technological Barriers	12	3.556	4.041	59.113	New tech access, implementation, data security, MVP, data storage, maintenance, tech talent, cyber risk, technical debt, innovation pressure
8	Socio-Environmental Challenges	7	3.011	3.421	62.534	Societal attitudes, family pressure, time management, economic issues, globalisation, corruption, exit challenges

7. DISCUSSION

The eight-factor solution derived from this study presents a theoretically coherent and practically interpretable portrait of the startup challenge landscape in Southern Kerala. Several cross-cutting themes merit particular attention.

The relative parity in rotated variance between Factor 1 (12.58%) and Factor 2 (12.32%) suggests that foundational and operational challenges are of comparable structural importance — a finding that challenges the conventional narrative that financial constraints dominate all other startup barriers. While financial constraints (Factor 3) remain significant, they rank third in explanatory power, indicating that the sequencing of challenges may differ from patterns observed in more capital-constrained economies.

The market factor (Factor 4) is the most variable-rich dimension of the entire solution, encompassing 17 items that span the complete marketing value chain. This breadth reflects the systemic nature of market development challenges in regional startup ecosystems where network effects, digital marketing infrastructure, and consumer digital adoption are all simultaneously underdeveloped. The emergence of regional market access as the single highest-loading variable in the entire factor solution (0.792) provides a quantitative anchor for the qualitative assertion that geographic confinement is the defining market constraint for South Kerala startups.

The appearance of a distinct organisational process factor (Factor 6), separate from operational challenges, is an analytically significant finding. It suggests that startup founders conceptually distinguish between operational execution and institutional structuring — a distinction that has implications for how incubation and advisory support should be structured. Generic 'operations support' programmes may miss the organisational capability-building needs of growth-stage startups.

The technological barrier factor (Factor 7), while accounting for only 4.04% of rotated variance, carries outsized practical significance given the technology-intensive nature of the study population. Technical debt and cybersecurity risk loading together on a single factor reveals that technological sustainability challenges are systemic rather than isolated — addressing technical debt without simultaneously improving security posture, or vice versa, will produce suboptimal outcomes.

The socio-environmental factor (Factor 8) is notable for its inclusion of exit challenges alongside family pressure and corruption. The co-occurrence of these variables on a single factor suggests that exit difficulties in the Southern Kerala context are not purely economic but are embedded within a broader socio-institutional framework that includes social stigmatisation of failure, institutional frictions in dissolution processes, and the personal relational costs of unwinding founder commitments. This integrated view of exit challenges is not well-captured in the existing literature, which tends to treat exit as a purely financial or strategic decision.

8. CONCLUSION AND POLICY IMPLICATIONS

This study provides a comprehensive empirical mapping of the challenges confronting technology startups in Southern Kerala through the application of Exploratory Factor Analysis to a dataset of 300 respondents and 88 measured variables. The identification of eight distinct challenge dimensions — foundational, operational, financial, market-related, human resource, organisational, technological, and socio-environmental — constitutes both a theoretical contribution and a practical diagnostic framework.

From a policy standpoint, the findings support the case for differentiated, lifecycle-sensitive interventions rather than generic support programmes. For foundational challenges, state agencies should prioritise single-window registration facilitation, structured mentoring networks, and accessible pre-seed grant mechanisms that reduce the capital and information barriers confronting first-time founders. For operational challenges, investment in shared production infrastructure, accessible R&D facilities, and simplified licensing procedures would substantially reduce the friction costs borne by early-stage ventures.

Financial constraints call for the expansion of risk-tolerant, patient capital instruments — including revenue-based financing, convertible note mechanisms, and government co-investment schemes — that are better calibrated to the risk profiles of regional startups than conventional bank lending. The market dimension demands targeted investment in export promotion, e-commerce enablement, and regional brand-building programmes that extend startups' effective market boundaries beyond Southern Kerala's domestic footprint.

Human resource challenges require coordinated responses across the education, immigration, and labour policy domains, including enhanced ties between technical universities and the startup sector, retention incentives for technical talent, and flexible employment regulation that accommodates startup remuneration structures.

Technological barriers call for shared cybersecurity infrastructure, technical debt management advisory services, and accessible cloud computing subsidies that reduce the per-unit cost of technological operations for resource-constrained ventures.

Future research should extend this analysis through longitudinal panel studies tracking the evolution of startup constraints across growth stages, comparative cross-regional studies examining how ecosystems in other Indian states compare with Southern Kerala, and Structural Equation Modelling investigations that test causal relationships among the identified factor dimensions. The present study thus serves as both a diagnostic baseline and a foundation for a richer programme of empirical inquiry into the dynamics of regional startup ecosystems in India.

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