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The Inter-organizational Network Evolution Across the Tech-Startup Lifecycle Phases: A Cross-sectional Study in the Indian Context

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Abstract

Lately, Tech startups are considered an essential entity for a nation due to their ability to generate employment, innovative products, and contributions towards economic expansion. However, tech startups are new ventures with no prior existence and experience with deficient essential resources. To obtain extramural resources, tech startups depend on external firm networks such as incubators, accelerators, suppliers, customers, trade associations, or any other associated firm. Networks thus assist in resource accumulation and provide the much-needed competitive advantage to a startup. However, the resources needed vary across the startup stages. Stages play an essential role in deciding with whom the startups should interact (network partner types or network efficiency), with how many (network size), and patterns of interaction (network strength). Our regression analysis based on cross-sectional primary data from 98 tech startups reveals that stage significantly affects the network attributes of tech startups. Our results suggest that the stage negatively influences network size and network efficiency, i.e., network size and network efficiency reduce with startup progression, indicating the reduced structural embeddedness as the startup matures.
In contrast, the stage positively influences the network strength, i.e., the network strength increases with the startup progression, resulting in an increased relational dimension as the startup evolves. These results highlight the importance of network changes across the lifecycle stages of tech startups and thus contribute to the dynamic network literature. Accordingly, we draw the managerial and policy implications for creating and promoting networks for startup growth in the context of their lifecycle stages and identify the avenues for future research.

Keywords

Network size, network efficiency, network strength, tech startups, India.

1. Introduction

Tech startups are an asset for a progressive nation. However, startups in general and tech startups in particular face innumerable challenges due to the technical intricacies involved (Partanen et al., 2014). Therefore, the need for external support is even more for tech startups, making them depend on networks for vital resources. Tech startups depend on network linkages for resource acquisition that may be tangible(co-working space, parking facilities, machinery) or intangible(managerial skills, goodwill, human resources)(Eveleens et al., 2017), for bolstering the strategic position in the industry network(Chu & Yoon, 2020) and for attaining reputation(Baum et al., 2000; Shane & Cable, 2002) i.e., the networks assist in overcoming obstacles in every path of its journey. However, as different challenges surface across each developmental stage, the startup's inter-organizational network composition varies. The entrepreneurial literature witness numerous studies on network transformation for startup growth and development(Arenius & Laitinen, 2011). However, most studies are related to the entrepreneur's ego networks (considering the entrepreneur as the focal actor) or based on interpersonal relationships. There is a dearth of studies in the extant literature that highlight the inter-firm

network dynamics for startup growth. A handful of the studies on inter-firm alliances are related to static alliances and firm performance(Chu & Yoon, 2020). However, successful startups change the inter-organizational network composition to overcome the varying resource needs at every stage. Studying the inter-organizational pattern is crucial since the startup's network composition relates to the startup's survival (Batjargal, 2003; Lechner et al., 2006). The network evolution reflects the startup's readiness to take on the challenges ahead. In this paper, we define the **startup network** as the amalgamation of strategic and non-monetary associations with other firms (incubators, accelerators, R&D institutions, customers, distributors, suppliers, NGOs, trade associations, or any established players) to acquire resources that can provide a competitive advantage for the focal firm. The network composition is measured using structural dimension (network size and network efficiency) and relational dimension (network strength or strong and weak ties). The current study addresses the following questions:

1) Do the inter-firm network compositions of tech startups undergo transformation across their lifecycle stages?
2) If yes, how do they transform over the stages?The study attempts to understand the inter-organizational network pattern dynamics of tech startups in the context of an emerging nation i.e., India. Our findings contribute to improving the Indian entrepreneurial ecosystem since it is ranked lower relative to the benchmark entrepreneurial ecosystem (Bala Subrahmanya, 2021). Further, we believe that our paper makes significant contributions to the dynamic network literature by developing empirical evidence on how inter-firm network characteristics change, as evident from the emerging nation India. In the current study, the evolution of the network composition is studied by dividing the startup stages into creation, stability, and growth.

Our results reveal that network attributes differ across start-up lifecycle stages. However, the significant differences lie between creation and stability and creation and growth stages. Further, by controlling the top management team's demographic and firm characteristics, we found that having a team member qualified with business-related courses and the entrepreneurial intention to launch the startup positively influences network size and partner types (network efficiency). Further, unlike previous findings that explored the homogenous network structure in the case of female founders, our study posits that at least one female in the founding team brings in more diverse partner types in the network. The founding team, with an average age of 30-40, positively influenced the network size compared to the other age groups. The prior entrepreneurial experience had no significance on any network attributes, whereas the previous work experience impacted the network size negatively. The variables that influenced the network strength are the startup industry and the top management team size (TMT).
The paper is divided into five sections. Section two investigates the existing literature; section three explains the conceptual framework of the study, section four describes the data collection and statistical methods used for analysis. The fifth and last section discusses the results and draws the managerial implications, limitations, and scope for future work.

2. Literature review

Most of the successful entrepreneurs give credit to their network or connections for their startup achievement. Networks provide access to resources when time is of the essence(Baum et al., 2000). Networks are net worth for an entrepreneur. Networks are also referred to by different names, such as social capital(Bhandari & Yasunobu, 2009; Yli-Renko et al., 2002), alliance portfolio(Baum et al., 2000; Cacciolatti et al., 2020; Joseph & Raghunath, 2017; Pangarkar & Klein, 2001), and strategic alliances(Hwang & Park, 2007; Wratschko, 2009). In all these terminologies, networks mean a web-like structure(Dodd & Keles, 2014) with nodes (actors) and ties (interconnections or edges) linked to achieving an organization's goal. The actors in the network structure can be individuals, groups, or organizations. Startup founders can modify network structures to adapt to situations. Inter-organizational alliances are continuously formed, dissolved, and reformed(Kim et al., 2006). The inter-organizational alliances take on many forms, from co-creating network partners to equity-based alliances to marketing arrangements(Powell et al., 1996) to international collaborators. Thus, there is constant variation in the startup's inter-organizational network composition. Soetanto, (2019:140)defines network changes as changes in networks in response to challenges and needs during new venture development. Hence, the lifecycle stage approach is suitable for studying tech startups network issues.

2.1 Phase approach

Wilken (1979) was among the first researchers who identified the regular phases of an enterprise. However, in recent times, the life cycle approach has gained momentum in the entrepreneurial literature(Klyver, 2007), though the studies have determined different boundaries between the stages for the suitability of the study. Since

then, the startup has often been compared with a living organism that transforms through various developmental stages, meeting the required milestones that are not easily reversible (Kazanjian, 2016;Salamzadeh & Kirby, 2017). The primary assumption in the *phase approach* is that the firm follows a pre-determined pattern. In this paper, we follow the three-staged model as proposed by Bala Subrahmanya (2017)- Creation, Stability and Growth.

The **Creation stage** is characterized by high degrees of equivocality related to routines, resources, products, and the environment (Hite & Hesterly, 2001). The founder and the firm are initially inseparable. In this stage, the founder offers maximum time and effort for product creation. The redefining of ideas following the expert suggestions, developing the proof of concept, and prototype development leading to a Minimum Viable Product, and obtaining customer feedback takes place. Organizational structure and formality are absent in this stage. This stage is highly vulnerable and struggles to build and sustain the business. The startup in this stage is focused on setting up the new business and does not earn any revenue.

The next stage is the **stability stage**. After surviving the valley of death, the startup progresses to the stage of some certainty in routines and work role relationships. The final version of the product is ready to hit the market. The main focus here is to develop products and market them on a large scale. The new firm incurs cash flow although yet to earn any profit. This stage marks the establishment of a revenue stream but without any profit.

The final stage is the e**xpansion stage**. The startup in this stage observes initial profits year on year, slowly and steadily (Schutjens & Stam, 2003). The firm utilizes the capital flow for scaling up all aspects of the business. In this stage, the firm goes for customer acquisition along with retention. The firm now requires a more significant number of sales forces to reach out to new customers.

2.2 Entrepreneurial stages and Network activities

Network size

Networks enable entrepreneurs to obtain market-related information, funding-related information, and product development information in a way that help reduce transaction costs. Transaction cost has been cited as the principal reason behind network cooperation. Therefore, networks are related to increased profitability. Thus, for a young venture, the network size is positively related to the performance (Rothaermel,2001). Network ties shorten and accelerate the firms' learning process (Pettersen et al., 2015). Network size, which generally means the total number of useful network partners for a firm, is referred to in many ways in the literature. Baum et al., (2000) define total horizontal, vertical-downstream, and vertical-upstream alliances for a biotechnology startup as network size. Cacciolatti et al., (2020); Pangarkar & Klein, (2001) have defined network size in terms of total equity and nonequity alliances. Doblinger et al., (2019) consider five types of alliances: technology development, licensee, licensor, procurement, and project development alliances. By forming partnerships, startups can access social, technical, and commercially competitive resources that otherwise require years of operating experience(Baum et al., 2000). Since the resources embedded differ from each network partner, the network size changes as the startup evolves. In the emergence stage, the startups experience high uncertainty, unstable work roles, and a lack of track record with external parties(Baum et al., 2000). Inter-firm relations confer external legitimacy to juvenile firms, such associations reduce initial hazards of newness and smallness. Entrepreneurs in the creation stage need various resources, and personal networks can be an essential resource for starting a firm. Arenius & Laitinen(2011), in their network study of a single firm, found that the discussion networks (network size) decreased over time at the firm level. As the firm moves to the "Early growth stage" or "Stability stage," some form of entrepreneurial routine has been established and can make revenue enough for breakeven. The experience thus gained helps the firm owner to conduct the business in a relaxed manner. The entrepreneur concentrates on the critical network actors moving forward to the Growth stage unless faced with uncertain situations. Consequently, we hypothesize that:

Hypothesis 1a.: The creation stage network size is larger than the stability stage.

1b. The creation stage network size is larger than the growth stage.

1c. The stability stage network size is larger than the growth stage.

Network Efficiency

The second most crucial network attribute often understudied in the literature is network efficiency. The startup should focus on partner quality and ensure the network comprises diverse partners. The overall network composition significantly influences the startup performance. Network portfolios embedded in homogeneous ties provide redundant or generic information(Pettersen et al., 2015). Partner duplication leads to rivalry between the firm's partners, which can impact the firm's performance. Therefore, the founder should carefully weave the network portfolio. Network efficiency defines the diversity of information and capabilities per alliance(Baum et al., 2000). The startup focuses on technology development in the creation stage (Kazanjian, 2016). Powell et al., (1996) posit that the locus of innovation is no longer an individual firm but rather a collaborative effort, mainly where the knowledge base of the product lies in the intersection of various disciplines. The inter-firm alliances with network partners such as R&D, trade associations, university partners,

suppliers, and customers influence the cognitive innovation model(Xu, 2011). Engagement with different network partners leads to diverse knowledge flowing essential for developing a novel product (Ritala & Hurmelinna-Laukkanen, 2013; Sheng & Chien, 2016). Alliances with skilled innovators grant access to innovative methods and technological know-how essential for creation, notably collaboration with R&D institutions, incubators, and university labs(Baum et al., 2000; Powell et al., 1996). Hence, the requirement for a tech startup to approach heterogeneous network partners is higher in the creation stage. As the firm moves to the stability stage, the function is to commercialize the invention and produce it repetitively (Kazanjian, 2016). Partanen et al., (2014) claim that a portfolio of alliances with suppliers, distributors, and customers helps new ventures acquire resources required for commercialization. Further, in the growth stage, the main task is to attain profitability and set the future growth base. Going with the assumption that the network efficiency needed is highest in the earlier stages than the subsequent startup stages, we frame the hypothesis.

Hypothesis 2a: The creation stage network efficiency is higher than the stability stage.

2b. The creation stage network efficiency is higher than the growth stage.

2c. The stability stage network efficiency is higher than the growth stage.

Network strength

The term tie strength rose to fame with Granovetter's (1973) seminal work "The Strength of Weak Ties." The theory concludes that weak ties are far more resourceful than strong ties since a weak tie act as a structural hole or a bridge connecting to a distinct actor of other clusters(Granovetter, 1973). Generally, for interpersonal relationships, it is a practice to classify family, friends, and other close relationships as strong ties, and acquaintances are regarded as weak ties. While studying inter-organizational alliances of steel and semiconductor manufacturing industries, Rowley et al., (2000) classify equity alliances, joint ventures, and nonequity cooperative (R&D) ventures as strong ties and weak ties are operationalized as market agreements and licensing and patent agreements. Considering Granovetter's seminal work as the base, Capaldo(2007) operationalizes the inter-organizational classification of strong and weak ties by considering three partnering behaviors- duration of the relationship, frequency of interaction, and the intensity of collaboration. Hite & Hesterly(2016) propose that network structure is dominated by path-dependence ties (strong ties) in emerging firms, while in early growth, firms accumulate more calculative ties(weak ties). However, a strong tie in one stage can transform into a weak tie in subsequent stages or vice-versa. In a similar context, Keidel et al., (2021), find that the partners with whom the firm was connected strongly had dissolved in the subsequent networks. On the contrary, Soetanto, (2019a) finds that some weak ties in the earlier stage turned into strong ties in the following phases. However, most of the studies in the extant literature say that strong ties are essential resource providers in the initial stage, during which the startup is in the creation and planning stage with no identity, and its technology needs to be proven. Further, the weak ties that provide idiosyncratic knowledge are increasingly important in the subsequent stages of stability and growth. Hence, we form the hypothesis that:

Hypothesis 3a: Network strength in the creation stage is higher than in the stability stage.

3b: Network strength in the creation stage is higher than in the growth stage.

3c: Network strength of the stability stage is higher than in the growth stage.

It is against the above literature discussion that we propose a conceptual framework to test our research objectives.

3. Conceptual Framework

The conceptual framework in Figure 1 defines the hypothesized relationships between the lifecycle stages of start-ups and network parameters. To access indispensable resources that vary across the stages, startups depend on external support and networks, including incubators, accelerators, venture capitalists, R&D institutions, suppliers, customers, trade associations, or any established firm. Since every network partner is equipped with different resources, the network characteristics vary along the lifecycle phases of the startup. Further, we assess the impact of certain control variables on the network size, network efficiency, and network strength.

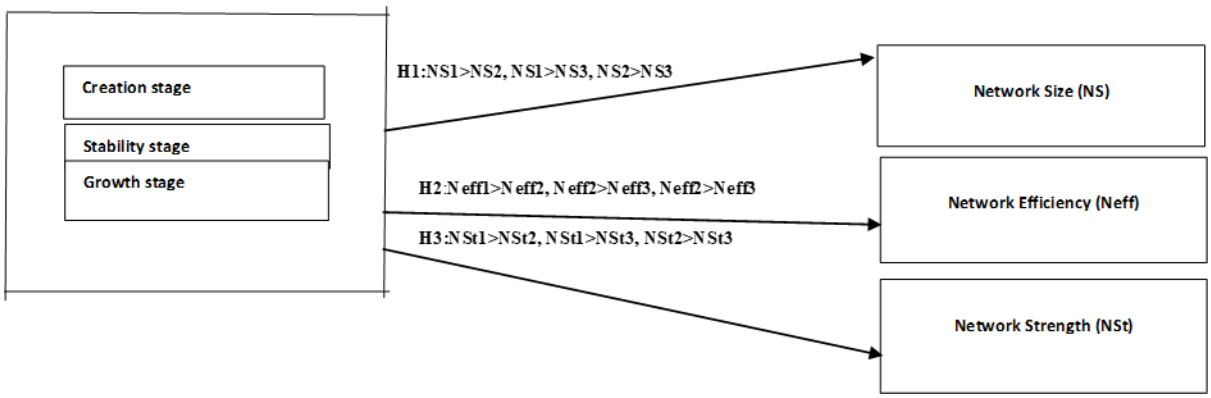

Figure1: Network attributes and the startup stages.

4 Methodology

4.1 Scope and data sources

We used the primary survey method to test the hypotheses due to the absence of a detailed, comprehensive secondary database of information about network size, alliances with different industry partners, and networking behavior. The questionnaire was then sent to the startups listed on secondary databases such as CrunchBase, Zauba corp. The email ids and contact numbers of the key informant were collected from the above-mentioned secondary databases and the respective startup's website and a customized message was sent asking for a convenient day and time for interaction. We highlighted the disclaimer in the email mentioning the anonymity of the respondents for collecting the data without any biases.

We chose a startup as per the definition of DPIIT (Government of India, 2023) from across the nation representing diversity, that is not over ten years old and has operating revenue of less than INR100 crore in any financial year. Existing enterprises acquired by a new firm or management or inheritance, franchises of any form formed through "spin-offs" from large firms were eliminated from the study (Bala Subrahmanya, 2015). The average age of the startups in our sample is 4.4 years. The startups chosen had one of the founding team members working with the startup following the recommendations of Lechner et al.,(2006). We restricted our sample to only tech startups since they must constantly depend on the networks due to their rapidly changing technological skills, market dynamics, and growth perspectives(Rasmussen & Mosey, 2015). The final sample consists of 98 tech startups that are less than ten years old, with revenue less than Rs.100 crore, in any location in India. All the information was self-reported by the key informants (CEOs or founders). A detailed list of variables is described in the following sub-section.

4.2 Dependent Variables

We have used three dependent variables for the study: the Network size, Network efficiency, and Network strength. To measure network attributes, we used a 1-year time lag. Respondents were asked in the questionnaire if the startups had been in the current stage for at least one year. In other words, the independent variables(stages) were measured at "t" and the dependent variable at "t-1"(network attributes). The purpose of introducing lagged network attributes is to establish a cause-effect relationship i.e firms develop networks in anticipation of future use. Lagged variables are undertaken in similar network studies(Baum et al., 2000; Greve & Salaff, 2003; Lechner & Dowling, 2003a; Lee et al., 2001). The explanation for each variable is defined below.

i) ***Network Size*****:** It is not so uncommon for tech startup founders to approach other firms for their businesses that are not monetary based but instead on friendlier terms. The reason for considering informal relations as network size is that numerous unaccountable informal associations may offer assistance which is more valuable than the formal ties' contributions(Powell et al., 1996). For calculation of network size, respondents were asked to indicate the count of all the inter-firm relationships, irrespective of the monetary exchanges whose inputs were instrumental for the business in the current stage i.e in:

- ***Creation stage:*** Respondents were asked to think back to the period just prior to the launch of their business when they were developing their business plan, planning for their product/service, and seeking funding and potential clients. They may have sought help from different organizations to discuss their business ideas, obtain feedback and other information, receive support, obtain raw materials, do market research, and so on.

- ***Stability stage:*** Respondents were asked to think of different organizations that were approached to acquire customers and penetrate the market, commercialize their products, hire employees, fund, and complementary resources, and so on.
- ***Growth stage:*** After the market penetration, they may have contacted different organizations to expand their company; develop business and new products, increase the size of the company and number of clients to retain and acquire new customers, enter other regional markets, and so on.

ii) ***Network Efficiency*****:** Denotes the diversity of network partners present in the network. Researchers in the past have used various alternative measures for calculating diversity, such as Herfindahl/Blau index(Al-Laham & Souitaris, 2008; Baum et al., 2000; Lahiri & Narayanan, 2013; Lechner & Dowling, 2003b) and entropy indices(Ruiz-Palomino & Martínez-Cañas, 2021; Yli-Renko et al., 2002). Though all these measures calculate the diversity, we have followed the method mentioned by (Baum et al., 2000) for computing network efficiency.

$$\text{Network Efficiency} = [1-\sum_{ab}(PA_{ab})^{\wedge 2}]/(NA_a)$$

Where PA_{ab} is the proportion of all startup A's alliances that are partnered with type b, and NA_a is the startup a's total number of alliances. Therefore, to compute network efficiency, the following variables were used. All the variables are the count variables.

Variables	Description
Financial Networks	The number of alliances with Vc's, BA's, Private equity, and Public sector banks to meet the firm's financial needs.
Marketing Networks	The number of alliances with i) other firms for understanding the market needs to develop the right product, ii) any important customer who acts as a referral to others or repeats the product purchase, iii) Or any distributors of the product.
Co-optetion Networks	The number of alliances with rival firms operating in the common market sectors, for accessing complementary assets where the main intention is to cooperate than to compete.
Privately held institutions	The number of alliances with private R&D institutions, private incubators, accelerators, and private university labs for accessing the essential resources for their businesses.
Publicly held institutions	The number of alliances with the Government incubators, accelerators, university labs, R&D institutions, Trade associations, or NGO's.
Reputational Networks	The number of alliances formed with other organizations mainly to gather recognition/fame.

The variables in the table are fed into the above formula to determine the network efficiency. Network efficiency ranges from 0 to 1. Zero for a new venture with no partnerships and 1 for very diverse partner types.

iii) Network Strength: is the assessment of the strength of the entire portfolio. For studies based on inter-organizational ties, the method for classifying the interpersonal relationship status is unsuitable (Capaldo, 2007). Hence, we used the linear combination of the following four variables for computing the network strength, adopted from Soetanto (2019a). However, unlike Capaldo(2007) we didn't record the four variables for every alliance partner the firm partnered with. Instead, we asked to rank the network strength variables for each partner type.

a)***Duration of the relationship:*** Respondents were asked to indicate on a scale of 1 to 5 the duration of the relationship with each network type, with 5 indicating knowing the partner type for many years (>5) and 1 for less than 6 months.

b) ***Frequency of the Interaction***: Respondents were asked to indicate on a scale of 1 to 5 the frequency of the interaction with each partner type, with 5 indicating interacting at least once a week either through a phone call, internet, or physically and 1 representing once in 6 months.

c) Resource Committed: Respondents were asked to indicate on a scale of 1 to 5 the importance of resources committed by the partner types, with 5 indicating extremely important and 1 least important.

d) ***Relationship Rank:*** Respondents were asked to assess the closeness of the relationship with the partner types, with 5 indicating extremely close and 1 low level of closeness.

The above-explained variables are used in the formula given by:

$(\sum_{p=1}^{n} Dp\ ^{+} \sum_{p=1}^{n} Fp^{+} \sum_{p=1}^{n} RCp + \sum_{p=1}^{n} Cp/4\text{n})/(4)$

A high value indicates a network dominated by strong ties and stronger relationships with the network types and vice versa.

4.3 Independent Variables:

The independent variable is the startup stages. We divided the stage into three: Creation, Stability, and Growth. The entrepreneurs were asked the following questions for identifying the startup stage:

Creation Stage: Have you been in the creation stage (POC, Prototype Development, Minimum Viable Product) for more than a year or have been in the revenue stage (earning revenue but no profit) for less than a year?

Stability stage: Are you currently in the stability stage (earning revenue with no profit) for more than a year or have been in the profitability stage (earning revenue and profit) for less than a year?

Growth stage: Are you in the profitability stage (earning revenue and profit) for more than a year?

4.4 Control Variables

Some control variables that may influence the three network attributes were added to the econometric model to isolate the effect of the independent variable, which are as follows:

I. Team Composition Variables

The network researchers' consensus is that a startup is better off when launched by teams rather than individuals (Greenberg & Mollick, 2018). According to the upper-echelon theory, the organization's outcome can be predicted based on the team's composition(Jin et al., 2017). In the case of new ventures, stakeholders often trade on the jockey, not the horse (Delmar & Shane, 2006). The team members assimilate different expertise into business operations. The essential trait missing in one team member can be overcome by others in the entrepreneurial team, positively impacting the new venture's performance. The team members' educational background, size, work and entrepreneurial experience, age, and motivation to start a startup influence the type of partners they discuss, the network size, and the relational strength. Hence, we control for team characteristics, which are as follows:

1. Business Level Education (BusiLevedu): Equals to 1 if one of the co-founders has undergone a course related to management, entrepreneurship, or business administration and 0 otherwise.
2. Educational Level (EduLev): Equals to 1 if one of the co-founders has a master's degree in technical education and 0 otherwise.
3. Gender Diversity (GD): Equals to 1 if one of the co-founders is a female and 0 otherwise.
4. Prior Entrepreneurial Experience (PEE): Equals to1 if one of the co-founders has an entrepreneurial experience in the past and 0 otherwise.
5. Average Age (Average): Equals 1 if the average age of the team is between 30-40 and 0 otherwise.
6. Prior Work Experience (PWE): Equals to 1 if one of the co-founders has prior work experience and 0 otherwise.
7. Motivation (IntExtM): Equals 1 if the startup's idea is inspired by internal motivation and 0 otherwise.
8. Top Management Team size (TMT): The respondents answered the Total number of directors in the top management in the survey.

II. Firm Characteristics

Besides, Team characteristics, researchers opine that firm characteristics also play a role in deciding the network ties. Hence, we controlled for:

1. Industry: Equals 1 if the startup is into manufacturing and 0 otherwise.
2. Operating Market (OM): Equals to 1 if operating locally and 0 if it has a nationwide presence.

4.5 Descriptive Statistics

We obtained results from 98 tech startups, of which 47.9% were in the creation stage, 25.5% were in the stability stage, and the rest (25.5%) were in the growth stage. Table 1 shows that the Indian startups, on average, had a network size of 11, meaning they interacted with 11 inter-firm relationships not based on monetary exchanges. This result is consistent with other researches (Batjargal, 2003; Drakopoulou Dodd & Patra, 2002; Greve & Salaff, 2003; Lechner et al., 2006)). Indian startup owners form a network portfolio that is 8% efficient, which means 8% of the alliances in the portfolio belong to other industries (Baum et al., 2000). The portfolio strength is around 36%, meaning most ties are weak.

Table 1: Descriptive Statistics

Sl.No	Variables	Mean	Std Deviation

1	Network Size	11.14	7.777843
2	Network Efficiency	0.07584	0.06480439
3	Network strength	0.3652	0.2456496
4	Stages	0.7857	0.8403485
5	Industry	0.602	0.4919935
6	Busilevedu	0.4796	0.5021519
7	Edulev	0.7245	0.449068
8	GD	0.1837	0.3892085
9	PEE	0.5204	0.5021519
10	Aveage	0.3673	0.4845607
11	PWE	0.7857	0.4124356
12	IntExtM	0.5612	0.4987888
13	OM	0.5816	0.4958273
14	TMT	2.704	1.465825

4.6 Method & Analysis

We ascertained our first research question i.e. if the inter-organizational network attributes vary across the tech startup's lifecycle stages using one-way Manova analysis, considering network attributes i.e. network size, network efficiency, and network strength as the dependent variables and startup stages as independent variables. The results are shown in Table 2. We observe that the results of all four variants of MANOVA are significant. Hence, we conclude that the input variables (network attributes) differ across the multivariate levels (Stages). This means the differences lie in at least between the two groups. To find out where the differences truly came from, we conducted the post hoc analysis using the **Bonferroni Test,** which is performed on each pair of groups. Table 3 shows that all three characteristics differ, but only with respect to the Creation and Stability stage and the Creation and Growth stage. We did not observe any differences between stability and growth stages concerning the network attributes. Therefore, hypotheses 1c, 2c, and 3c are rejected. This means that the network structure between stability and growth is the same, as inter-organizational network change is a complex task and gets implemented only when its change results in improved performance and the young venture can absorb the costs involved with the change (Kim et al., 2006). In a similar context, Eisenhardt et al., (1996) explains that firms cooperate when the benefit of cooperation exceeds that of proceeding alone. Firms develop what is known as "network inertia," which is defined as resistance to change the partners, but which is not due to poorly managed inter-organizational networks but as a by-product of previous successful management of networks that generated synergies for the participating organizations (Kim et al., 2006:705). Indian startups face regulatory hurdles in terms of strict compliance and regulations in conducting business. High taxes, stringent labour laws, and bureaucratic delays in obtaining licenses and permits are some hurdles that obstruct startups from expanding and growing[1]. The theory of neo-institutionalism proposes that an organization adheres to norms and cultural codes to gain legitimacy and to improve its survival chance (Meyer & Rowan,1977). The tendency to re-organize the inter-organizational network structure is lower when there is high pressure from the institutional environment to obey the norms (India was ranked 23 in terms of ease of doing business despite being ranked as 3rd largest start-up ecosystem globally **(2)**). Therefore, the chances of startups choosing a new partner in the subsequent stages are low since an enforceable trust is already built among the existing partner types.

Table 2: Manova Result- Network Attributes versus Stages

	Effect	Value	F-statistic	P-value
Stage	Hotelling-Lawley	0.40152	6.1566	6.661e-06 ***
	Roy	0.38637	12.106	9.067e-07 ***
	Wilks	0.71055	5.7761	1.55e-05 ***
	Pillai	0.29361	5.3914	3.664e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
| Eta2 (partial) |: 0.22.

Post-hoc analysis test

Table 3: Bonferroni Test for multiple comparisons.

Network size with stages		
	Creation	Growth
Growth	0.00089	-
Stability	0.00157	1

Network efficiency with stages		
	Creation	Growth
Growth	0.0012	-
Stability	0.0463	0.8709

Network strength with stages		
	Emergence	Growth
Growth	0.0032	-
Stability	0.0734	1

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

5 Results & findings

Table 4: Regression Analysis predicting Network size, Network efficiency, and Network strength as a function of startup stages.

	Model I	Model II	Model III
Variables	Network Size	Network Efficiency	Network Strength
Stability (Creation as the reference)	-0.16102**	-0.08103**	0.09081*
Growth (Creation as the reference)	-0.17958**	-0.08035*	0.14261***
Industry			0.06611*
Busilevedu	0.13667**	0.05364*	-0.05945.
GD		0.06539*	
PWE	-0.13752*		
Aveage	0.12402**		
OM	-0.09284.	0.04432.	
TMT			0.18456*
IM	0.09815*	0.06955**	
Adjusted R-squared	0.2996	0.2204	0.1803
F	6.928***	5.571***	4.76***
Constant	1.06012***	0.16505***	0.3597***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Therefore, we developed three stepwise regression models considering the Creation stage as the reference variable versus the stability and growth stages. Our focus from now on is to analyze these three models in detail.

Table 4 shows that the creation stage network size is larger than the stability and growth stages. Thus, hypotheses 1a and 1b are supported. Greve & Salaff (2003) found striking similarities in their cross-sectional study of network activities in four countries. The finding is as per the expectation that due to the high failure rate in the creation stage (Baum et al., 2000; Mccarthy et al., 1991), the founders are extremely cautious and approach numerous people for the affirmation related to the business idea, product creation, and development. New product development is increasingly becoming a collaborative task (Powell et al., 1996) as the competitive advantage of the technology-based industries relies on the technological characteristics of the products and services (Tödtling, 1994). In the creation stage, since the business is yet to take off, the startup does not have an identity of its own and is known mainly due to the founder and the founding team. So, most of the relationship is on friendlier terms. The larger the firms' informal networks, the faster access to necessary resources, resulting in faster diffusion of innovation due to relaxation in the "warm-up period" during which the actors understand each other better(Lechner et al., 2006). As the new venture grows, making revenue and profit, the management team has gained experience by formally conducting the business since the new venture growth and entrepreneurial development are co-evolutionary (Batjargal, 2006; Kreiser et al., 2013). Therefore, the dependability on other organizations based on informal relations is reduced. Hence, our study supports hypotheses 1a and 1b. Similarly, our results support hypotheses 2a and 2b that network efficiency is highest in the creation stage versus stability and growth stages. In the creation stage, the primary function is confined to product development, and innovation is often found in the interstices between firm, universities, research laboratories, suppliers and customers(Powell et al., 1996).The new product development involves greater complexity and requires greater scope and breadth of the founder's understanding of the new product development(Xu, 2011). Therefore, the founder interacts with diverse actors such as initial customers to meet the customer needs, is busy partnering with research organizations and incubators, trying to raise seed funds to accommodate the product development cost, following helpful discussions with suppliers, or reaching out to the established players for gaining recognition. A diverse network structure of different partner types gives rise to non-redundant information and knowledge (Homberg & Bui, 2013; Pangarkar & Wu, 2013) essential for technical-intensive products. However, the requirement for a diverse or heterogeneous network structure reduces as the firm grows. The main task in the stability stage is to attain new customers, and in the growth stages, to enhance customer loyalty and to develop second-generation products, although on a minor level (Kazanjian, 2016). Thus, attracting customers is an essential part of both the stages that the founders resolve by hiring a sales force. Besides, it is also a common feature to exit from the former association of early-stage startup aids such as incubators, accelerators, TiE, and NASSCOM and build a core team of experts. Technology too, can play a significant role in enticing customers. The Indian market has become heavily dependent on technology. It is going for a cashless economy after a massive boost by the government to promote digital payments and support nationwide technology infrastructure called “India stack”(Startup Genome, 2022). Such e-commerce space brings in a lot of buyers and sellers together, eliminating the role of intermediaries like distributors and other similar network types. The use of e-platform to connect with customers has increased significantly after the outbreak of COVID-19 pandemic [(3)].

Further, from table 4 the network strength increases as the startup grows. Hence, our hypotheses3a and 3b, which state that the network strength is higher in the earlier stages, are rejected. This result is supported by vast studies that weak ties are more favourable for creating novel products. The stability stage is dominated by meeting sales target/marketing-related problems in which strong ties are more influential in word-of-mouth marketing instead of weak ties (Hu et al., 2019) and create a multiplier effect when the prospective customers receive feedback from the existing ones (Mukul & Saini, 2021). In the growth stage, the founders spend most of their time planning for future activities (Mccarthy et al., 1991). They revisit their earlier partners since trust plays a significant role in networking relations. Hence, the entrepreneurs approach the partners known to them earlier, with whom they are close, and can share future plans and other confidential information during which period they interact frequently. The close inter-firm alliance relationship shares manufacturing or customer information that places them ahead of their competitors, especially when the market is highly competitive(Eisenhardt et al., 1996). Entrepreneurs develop relational inertia where there is a high possibility to utilize the ties in future events with whom they have interacted in the past or have enduring relationships (Batjargal, 2006). Their bitter networking experiences with network actors pivot them to few yet resourceful and committed ties reflected in reduced network size and efficiency and increased network strength. Also, in the creation stage, the ecosystem stakeholders hesitate to dedicate their time and resources to an unproven idea.
Moving on, the control variable Busilevedu has a positive effect on network size and network efficiency. These findings support the recent studies on network cooperation(Martin et al., 2019), which state that entrepreneurial education enhances the business acumen that favours network formation and cooperation. Since entrepreneurial students know that priority decisions are embedded within networks, they do not hesitate in network formation (Greve & Salaff, 2003). However, it was surprising that the technical education (EduLev) did not have significance on any network attributes. This means that having technical expertise in the team does not lead to

network formation. Perhaps the courses taught in B schools or entrepreneurship curricula impart the essential communication and soft skills to improve networking competencies and entrepreneurial potential. Therefore, entrepreneurs can hand over the networking activity to the founders with management or entrepreneurship educational backgrounds, and the technical founders may mainly concentrate on product development. Another variable that impacts network size and network efficiency is internal motivation. The internal zeal to solve the societal problem with a scientific approach, experienced by the founding team, backed by the secondary motto of earning gains from entrepreneurship, encourages cooperation with the network partners compared to an entrepreneur whose primary motto is to fetch profits from the business (external motivation)(Martin et al.,2019). The prior entrepreneurial experience had no impact on the network characteristics. In contrast, the prior work experience negatively influenced the network size i.e. entrepreneurs with the former work experience form less informal ties with the other organization. The prior industry experience exposes the founders to industry rules and regulations, customer and supplier networks, and environmental practices (Delmar & Shane, 2006). They become well-versed in organizing firms and resources, making them less dependent on external support. Further, from table 4 we see that industry has a positive impact on network strength i.e manufacturing startups depend on a more familiar network partner than service-oriented startups. Batjargal (2006) proposes that manufacturing firms mainly rely on a few clients on whom their revenue depends. Hence, such manufacturing firms must develop strong relations with those limited customers. Moving on, our study contrasts the previous findings that the female network composition is less efficient and embedded in the personal networks. However, the presence of a female in the founding team gives an opposite dimension to the prior findings. The inclusion of gender diversity positively influenced network efficiency.

Further, we compare the average age team of 30-40 with other age groups. Several reports claim that the Indian entrepreneurial age group is the youngest (around 31) compared to the advanced countries **(4)**. The TMT with an average age of 30-40 positively impacted network size compared to other age groups. This shows that networking behavior is influenced by an individual's age. Further, top management team size positively impacted the strength of the network. Generally, for young firms, TMT's social relationships have an emphasis on alliance formation i.e., large top management team size has many extensive relationships with partnering organizations (Eisenhardt et al., 1996). Such close relationships build trust and familiarity, which is essential for inter-organizational relationships.

5. Conclusions

Implications and Scope for Future Research

The success of a business lies in its networking competencies. Networks are helpful in every facet of the business. However, our study on Indian tech startups finds that though networks are essential in all phases of business establishment, they are essential in the creation stage. Hence, startups are heavily involved in networking with informal (network size) and formal ties (network efficiency) in the creation stage versus stability and growth stages. After that, the entrepreneur internalizes most tasks depending on the core networks sharing strong relations (network strength). With networking experience over the years, the entrepreneurs realize their true partners and the "*friends in need*". Therefore, it forms cooperative ties with close ones in the later stages of startup journey. Further, our study highlights that business education and internal motivation positively impact the network size and network efficiency. Regarding past occupational experiences, prior work experience curtailed the network size, whereas the entrepreneurial experience had no significance on any network attributes. Negating the previous studies, our study witnessed that at least one female member in the founding team positively influenced partner diversity in the network (network efficiency). Finally, the team age group between 30-40 attracted a network of considerable size. However, only the industry and TMT size significantly influenced the network strength. Our study contributes to the dynamic network literature by not taking the entrepreneur's network, which has been extensively studied rather, the focal actor is the startup itself. Therefore, the unit of analysis is the networks of startups. The entrepreneurs' takeaway from the study is that since networks play an essential role for a young venture explicitly in the creation stage, entrepreneurs should be quick to utilize inter-organizational relationships to gather resources. For policymakers, our study elucidates the network's importance, particularly to the creation stage, because of the high failure rate in the creation stage. This failure rate is even higher in tech-based startups that only survive up to a couple of years of operation (Satyanaryana et al,2021;NASSCOM, 2014; Bala Subrahmanya, 2020). Therefore, policymakers should relax the stringent rules and regulations until the startups traverse the "Valley of Death" stage.

Hence, there is a need for conducting specialized mentoring or consulting programs to provide emotional support, guidance, and networking catering to the creation stage founders because tech startups have a greater chance of early emergence when inserted into the favorable entrepreneurial ecosystem (Bala Subrahmanya, 2020).

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