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Research Article

Business Incubator Services and Startup Competitive Capabilities: Evidence from Incubated Ventures in Algeria

Abd Elhadi Bougoffa[1*] and Selma Ataouat[2]
[1]University of Kasdi Merbah-Ouargla, Algeria
[2]University of Algiers 3, Algeria

***Corresponding Author**
Dr. Abd Elhadi Bougoffa
(abdelhadibougoffa030@gmail.com)

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Abstract: Business incubation is increasingly delivered as a portfolio of material, advisory, financial, technical, learning, and relational services, yet these components need not relate equally to venture capabilities. This study examines how five dimensions of incubator support are associated with the competitive capabilities of incubated startups in Algeria. A cross-sectional survey of 50 respondents representing ventures associated with 19 business incubators was analyzed primarily using descriptive statistics and Pearson correlations, group comparisons and model-based analyses were treated as secondary evidence. Respondents reported a high overall level of incubator services (M = 4.14), whereas competitive capabilities were moderate (M = 3.43). Overall services were positively associated with competitive capabilities ($r = 0.640$, $p<0.001$). The association was strongest for communication and relationships ($r = 0.648$), followed by technical and financial support ($r = 0.597$), training and workshops ($r = 0.580$), material resources ($r = 0.420$), and human resources and consulting ($r = 0.339$). The results show a heterogeneous pattern of service-level associations, with relational, technical-financial, and learning-oriented support displaying the largest observed coefficients in this sample. They also show that high reported service provision can coexist with only moderate competitive capabilities, distinguishing support delivery from capability formation. Because the design is cross-sectional and observational, the findings are interpreted as associations rather than causal effects.

Keywords: Business Incubators, Startups, Competitive Capabilities, Entrepreneurial Ecosystems, Networking Support, Algeria

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INTRODUCTION

Business incubators have become established components of entrepreneurial ecosystems because young ventures often enter markets with limited resources, incomplete managerial experience, weak external networks, and restricted access to finance, technology, and specialized knowledge. Modern incubation programs therefore extend beyond the provision of workspace. They typically combine material infrastructure with consulting, technical and financial assistance, training, mentoring, networking, and access to external actors [1-3]. This broader service portfolio has shifted the research question from whether incubators merely provide shelter for new ventures to how different forms of incubation support relate to venture development.

The empirical literature increasingly shows that incubation can benefit startups, but the effects are not uniform. Recent studies distinguish among different incubator capacities, network mechanisms, program designs, and organizational settings, while recent meta-analytic evidence reports substantial heterogeneity in incubation outcomes. Wang *et al.* [3], for example, show that different incubator capacities are not equally associated with regional innovation performance. Woolley and MacGregor [4] likewise find that venture-development programs differ substantially in their

characteristics and performance dimensions. These findings imply that treating incubation as a single aggregate intervention can conceal important differences among the mechanisms through which support is delivered [4,7].

One mechanism that has received increasing attention is relational support. Incubators may create value not only by supplying internal resources but also by connecting startups with investors, customers, mentors, peer ventures, universities, and other ecosystem actors. Van Rijnsoever [8] conceptualizes this role as network intermediation, while Wu *et al.* [9] report positive relationships between incubator networks and new-venture performance. Sullivan *et al.* [10], however, show that network ties do not benefit all learning and performance relationships equally. Taken together, this literature suggests that networking and relational support can be important, but that their value is contingent rather than universal.

Other dimensions of incubation support are also likely to matter differently. Training and workshops can contribute to entrepreneurial learning, technical and financial support can reduce resource and knowledge constraints, consulting can provide specialized advice, and material resources can reduce basic operating barriers. Yet these services need not translate into competitive capabilities with the same strength. This distinction is especially relevant for startups, where the development of capabilities such as innovation, quality improvement, market adaptation, customer retention, market access, and sustainable competitive positioning may depend on how external support is absorbed and applied rather than on service availability alone.

What remains less clear is how distinct categories of incubation support relate to the same competitive-capability outcome within emerging entrepreneurial ecosystems. The Algerian setting provides a useful context for examining this question because university, public, and private incubation structures coexist within a still-developing support environment. Prior Algerian research has already examined business incubation, entrepreneurial support, innovation, and competitiveness, the contribution of the present study therefore does not rest on a claim that incubation has been ignored in Algeria. It rests on comparing the relative associations of distinct support dimensions with a common competitive-capability outcome across a multi-incubator sample.

This distinction is important because the data reveal a pattern that would be obscured by an aggregate treatment of incubation. Respondents reported a high overall level of incubator services, but only a moderate level of competitive capabilities. At the same time, the overall service measure was positively associated with competitive capabilities, and the strength of the association differed substantially across the five service dimensions. These results raise a more precise question than whether incubators "work": how do different forms of support relate to the competitive capabilities reported by incubated startups?

Accordingly, this study examines five dimensions of incubation support: material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relationships. Competitive capabilities are measured separately through respondents' assessments of the venture's ability to innovate, improve quality, reduce costs, access markets, build a brand, develop team skills, attract and retain customers, adapt to market change, and achieve sustainable competitive advantage. The empirical strategy uses cross-sectional survey evidence from 50 respondents representing ventures associated with 19 Algerian business incubators and evaluates the overall and dimension-specific associations using descriptive statistics and Pearson correlations, with group comparisons and model-based analyses treated as secondary evidence.

The study addresses two research questions:

- **RQ1:** How are business incubator services associated with the competitive capabilities of incubated startups in Algeria
- **RQ2:** How do the observed associations with competitive capabilities differ across material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relational support

The article makes three contributions. First, it provides dimension-specific evidence by comparing five forms of incubator support against the same competitive-capability outcome rather than treating incubation as a single undifferentiated exposure. Second, it highlights the particular salience of relational support within the observed sample, complementing literature that emphasizes incubators' role as network intermediaries. Third, it distinguishes between service provision and capability formation: the coexistence of highly rated incubation services with only moderate competitive capabilities cautions against treating support availability as equivalent to venture-level capability development.

These contributions are intentionally bounded. The study is cross-sectional and observational, so the reported relationships are interpreted as associations rather than causal effects. The supplementary regression, CHAID, and

neural-network models are used as descriptive extensions rather than as validated out-of-sample prediction exercises. Within these boundaries, the study provides a differentiated account of how incubation-service composition relates to competitive capability in an emerging entrepreneurial ecosystem.

The remainder of the article is organized as follows. Section 2 reviews the literature on multidimensional incubation support, capability formation, and relational mechanisms. Section 3 describes the research design, sample, measures, and analytical procedures. Section 4 presents the empirical results. Section 5 discusses the findings in relation to the current incubation literature. The final sections present implications, limitations, future research directions, and the conclusion.

Literature Review and Conceptual Background

Business Incubation Beyond Physical Infrastructure: Business incubation has evolved from a model centered primarily on workspace and shared facilities toward a broader support architecture that combines physical resources with advisory, financial, technical, learning, and relational services. Earlier service classifications already distinguished infrastructure, education, business assistance, and networking as separate components of incubation [11], while subsequent reviews emphasized that incubator effectiveness cannot be reduced to the provision of premises alone [1,12]. More recent evidence similarly treats incubation as a portfolio of heterogeneous mechanisms rather than a single intervention.

This evolution matters because startups typically enter incubation with multiple and partly interdependent constraints, including limited resources, incomplete managerial experience, weak market access, and restricted external networks. Incubators can address these constraints through combinations of physical infrastructure, knowledge transfer, training, specialized advice, financing access, and external connections. Rubin *et al.* [13], for example, show how collaboration within technological incubators can strengthen technological, market, and financial knowledge, while Eveleens *et al.* [2] conclude that network-based incubation can provide resources, capabilities, knowledge, learning, and social capital even though the subsequent translation of these benefits into startup performance is not always straightforward.

Empirical studies also demonstrate that different incubation capacities are not equivalent. Wang *et al.* [3], using panel data from 31 Chinese provinces, distinguish several incubator capacities and report unequal relationships with regional innovation performance, with broader incubation capacity showing a stronger association than basic and finance capacities. Yuan *et al.* [7], using panel data from 857 national-level technology business incubators in China, likewise find that people, technology, capital, and infrastructure factors differ in their associations with incubator performance. These studies support the view that service composition and context matter.

Heterogeneity is also visible in studies comparing incubation and acceleration models. Woolley and MacGregor [4] find that private incubators, university incubators, and accelerators differ substantially in their relationships with nanotechnology venture outcomes. Cánovas-Saiz *et al.* [14] show that accelerator characteristics are associated with different funding and survival outcomes, while Madaleno *et al.* [15] conclude from systematic OECD-wide evaluation evidence that incubator and accelerator effects depend partly on ecosystem characteristics and program design. Yu [16] further illustrates why support programs should not automatically be equated with uniformly positive outcomes: accelerator participation can alter funding and closure dynamics in ways that reflect both selection and treatment effects.

The latest quantitative syntheses reinforce this differentiated view. Seitz *et al.* [5], in a meta-analysis of 22 empirical studies and 65 effect sizes, report a statistically significant but small average relationship between incubator participation and new-venture performance, together with substantial heterogeneity related to program specialization, sponsorship, service configuration, and regional context. Murillo-Rojas *et al.* [6], synthesizing 39 empirical studies covering 55,219 firms, similarly find that incubation effects differ across innovation, growth, survival, profitability, and employment, and that support mechanisms and ownership structures moderate these outcomes.

Taken together, the literature suggests that the more informative research question is not whether incubators are uniformly beneficial, but how distinct components of the incubation bundle relate to specific venture outcomes. This distinction is especially important when the outcome is competitive capability rather than short-term firm performance.

Incubation Services and Capability Formation

The capability-building perspective provides a useful way to organize the services examined in the present study without redefining the constructs used in the study. The study operationalizes incubator support through five dimensions: material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relationships. Competitive capabilities are measured separately through nine items

reflecting the venture's reported ability to innovate, improve quality, reduce costs, access markets, build a brand, develop team skills, attract and retain customers, adapt to market change, and sustain competitive advantage. These constructs are retained as measured and are not relabeled as dynamic capabilities.

Prior research nevertheless provides a useful conceptual basis for understanding how external support may relate to capability development. Fang *et al.* [17] show that tenant-incubator social capital can facilitate interorganizational learning and, in turn, technological capability and managerial competence. Hughes *et al.* [18] similarly argue that incubation outcomes depend not merely on being located in an incubator but on how ventures use strategic networking opportunities to obtain resources and knowledge. Rakthai *et al.* [19], studying businesses that passed through university incubators in Thailand, report positive relationships among network capacity, innovative capacity, and entrepreneurial performance.

Learning-oriented evidence also supports the view that capability formation is mediated by how entrepreneurs absorb and apply support. De-Pablos-Heredero and Blanco Jiménez [20], examining 24 Spanish business accelerators, report that accelerator practices contribute differently to startup capabilities and performance. Their dynamic-capabilities framework is not identical to the competitive-capability construct used in the present study, but it demonstrates that support practices can be linked to capability development through organizational learning and adaptation. Asensio-Ciria *et al.* [21] likewise identify counseling, communication channels, and training as relevant components across different phases of the incubation process.

Training, finance, and technology support also show differentiated associations in empirical work. Ahmed *et al.* [22], using a sample of 567 respondents, report positive relationships between networking services, capital support, training programs, and sustainable entrepreneurship growth. Yuan *et al.* [7] find that technology-related factors are consistently associated with technology-incubator performance across national and regional models. De-Pablos-Heredero *et al.* [23] further show that different incubator tools, advice, and services were associated with startup survival during the COVID-19 period, illustrating how the relevance of support can vary with the nature of the external challenge.

A more recent emerging-market study by Yoruk *et al.* [24] examines 403 startups and shows that business-incubator support strengthens the performance relevance of longer-term dynamic capabilities more strongly than short-term bricolage. Dynamic capabilities are not interchangeable with the competitive capabilities measured here, the study is therefore treated as adjacent rather than directly equivalent evidence. Its relevance lies in showing that incubation can matter differently depending on whether support is used to address immediate shortages or to build reusable organizational capabilities.

This distinction is central to the current article. Material resources can reduce immediate operating constraints, technical and financial support can improve access to technology, expertise, and funding opportunities, training and workshops can strengthen entrepreneurial learning, human-resource and consulting services can provide advisory knowledge, and relational support can expand access to partners, customers, investors, and ecosystem actors. The present study does not presume that these mechanisms are equally important and does not infer causality from their observed associations.

Relational and Network Support

Relational support deserves specific attention because modern incubators increasingly operate as intermediaries within entrepreneurial ecosystems rather than only as providers of premises and administrative services. Their value may arise partly from connecting startups to actors who control information, legitimacy, expertise, finance, or market access.

A substantial stream of literature supports this interpretation. Hughes *et al.* [18] position social capital and strategic networking as central mechanisms through which incubated firms may create value. Fang *et al.* [17] show that social relationships with incubators can facilitate organizational learning and capability development. Rubin *et al.* [13] demonstrate that interactions among incubatees, graduates, and incubator management can strengthen knowledge flows, while Redondo and Camarero [25] find that bridging social capital—relationships with external agents—has greater business relevance than purely internal bonding ties in university incubators.

More recent research develops this network-intermediation perspective further. Van Rijnsoever [8] conceptualizes incubators as intermediaries capable of reducing weak-network problems in entrepreneurial ecosystems. Wu *et al.* [9], using data from 205 new ventures in Chinese incubators, find positive relationships between incubator internal and external networks and venture performance, with entrepreneurial orientation and environmental dynamism shaping those relationships. Kiran and Bose [26] also identify networking as an important predictor of technology-business-incubator performance in India.

Evidence from emerging economies provides additional context. Khokhawala and Iyer [27] show how incubator networks can help novice entrepreneurs span institutional gaps through interactions with mentors and other incubatees. Antunes *et al.* [28] describe network orchestration as an additional incubator role in the formation and development of incubated business networks. These studies reinforce the idea that relational support is not merely an ancillary service but can form part of the mechanism through which incubation connects ventures to external resources.

At the same time, the network-performance relationship is contingent. Sullivan *et al.* [10] show that reliance on different network ties changes the relationship between learning activities and early venture performance: weak ties can strengthen outcomes in some learning domains but weaken them in others. Eveleens *et al.* [2] similarly conclude that network-based incubation clearly generates intermediary benefits, while the performance consequences of those benefits remain more ambiguous. Thus, relational support should be treated as potentially important without assuming that more networking is always better.

The recent meta-analysis by Murillo-Rojas *et al.* [6] is especially relevant because it distinguishes *bridging* mechanisms—linking startups to investors, customers, mentors, and expert networks—from *buffering* mechanisms such as subsidized space and routine administrative support. Their results indicate that bridging-oriented models tend to produce stronger outcomes. This does not establish causal superiority of relational support in the Algerian sample, but it provides a strong basis for analyzing communication and relationships as a distinct dimension.

Evidence Heterogeneity and Research Positioning

The accumulated evidence indicates that business incubation is associated with positive venture outcomes on average, but the magnitude and even direction of those outcomes vary across designs, contexts, and indicators. Reviews have long noted conceptual and methodological fragmentation in the field [1-2,12]. Accelerator research reaches a similar conclusion: Crișan *et al.* [29] identify multiple mechanisms through which accelerators operate, including learning, market access, growth support, and innovation, rather than a single uniform effect.

Empirical evidence likewise cautions against simple performance claims. Sedita *et al.* [30] find that incubation is associated with startup innovation performance and can interact with technical capabilities and collaboration portfolios. By contrast, Yee and Choi [31] show that accelerator participation in Korea increased asset turnover through sales growth without producing a corresponding improvement in return on assets. Yu [7] finds yet another pattern, in which accelerators can accelerate the resolution of uncertainty and closure decisions rather than simply maximizing capital raised. These studies demonstrate that support programs can be beneficial while producing different results depending on the performance metric considered.

The two 2026 meta-analyses consolidate this conclusion. Seitz *et al.* [5] report a small positive average effect alongside substantial heterogeneity associated with governance, service design, timing, and context. Murillo-Rojas *et al.* [6] find stronger effects for innovation and modest effects for growth, while effects on survival, profitability, and employment are weaker or inconsistent. These findings imply that a broad research question asking whether business incubators "work" would add limited value.

The present article therefore focuses on service-level heterogeneity within one competitive-capability outcome. Rather than treating incubation as a single exposure, it distinguishes material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relational support. The study asks how these dimensions are associated with the same competitive-capability measure in a multi-incubator Algerian sample.

This positioning also avoids a country-only novelty claim. The value of the Algerian context lies in extending the empirical base to an emerging incubation ecosystem, not in assuming that incubation has not previously been studied in the country. The contribution rests instead on the combination of a differentiated service structure, a common capability outcome, and a clear associational comparison across dimensions.

The study addresses the following research questions:

- **RQ1:** How are business incubator services associated with the competitive capabilities of incubated startups in Algeria
- **RQ2:** How do the observed associations with competitive capabilities differ across material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relational support

These questions deliberately use associational rather than causal language because the cross-sectional design does not identify causal effects.

MATERIALS AND METHODS

Research Design and Study Setting

The study employed a quantitative cross-sectional survey design to examine the relationship between business-incubator services and the competitive capabilities reported by incubated ventures in Algeria. The study used a descriptive-analytical approach and relied on questionnaire data collected from entrepreneurs and owners of projects

Table 1: Structure of the incubator-service measure

Part	Incubator-service dimension	Items	Role
Part I	Material resources	4	Incubator-service dimension
Part I	Human resources and consulting	4	Incubator-service dimension
Part I	Technical and financial support	4	Incubator-service dimension
Part I	Training and workshops	3	Incubator-service dimension
Part I	Communication and relationships	3	Incubator-service dimension

hosted by Algerian business incubators. The article retains the original empirical design without introducing new variables, estimators, controls, or re-estimation procedures.

The study defines the geographical scope as the Algerian national territory and the human scope as entrepreneurs and owners of projects incubated within Algerian business incubators. The documented study period extends from 2021 to 2025. Because narrower questionnaire fieldwork dates are not separately documented, the article retains 2021–2025 as the temporal scope without making a more specific claim about the exact administration dates.

The design is observational and cross-sectional. Accordingly, the empirical relationships are interpreted as associations within the observed sample rather than as causal effects.

Study Population and Sample

The study population consists of entrepreneurs and owners of projects incubated within Algerian business incubators. The research process used a pilot sample of 20 entrepreneurs and project owners to assess the suitability of the questionnaire and a final analytical sample of 50 respondents representing incubated ventures. The pilot and final samples represent distinct stages of the research process. Because respondent-level identifiers are not available, no further claim is made about individual overlap between the two stages.

The questionnaire was initially targeted to 60 respondents. Fifty-four questionnaires were returned, corresponding to a 90% return rate. Four returned questionnaires were excluded because they were incomplete, leaving 50 questionnaires suitable for analysis. The final analytical sample therefore represented 83.3% of the 60 questionnaires initially targeted.

The final sample covered 19 business incubators of different organizational types. Of the 50 incubated projects, 29 were associated with university incubators (58%), 17 with public incubators (34%), and 4 with private incubators (8%). This distribution provides observations from several incubation environments rather than from a single institution.

The source study describes the sample as randomly drawn from the study population. However, the operational sampling frame and respondent-selection procedure are not documented in sufficient detail to establish a formal probability-sampling design. The article therefore reports the sample composition and recruitment outcome without making a stronger representativeness claim.

Respondent and Venture Characteristics

The questionnaire collected demographic and venture-level descriptive information including gender, educational level, age, the alignment between the entrepreneur's specialization and the venture's activity, number of founders, principal sector of activity, and the venture's current stage of development.

In the final sample, 24 respondents were male (48%) and 26 were female (52%). Educational attainment was concentrated at the university level: 39 respondents (78%) held a licence/bachelor's or master's degree, 8 (16%) had postgraduate education, and 3 (6%) had secondary education or below. The age distribution comprised 10 respondents under 25 years (20%), 25 aged 25–35 (50%), 10 aged 36–44 (20%), and 5 aged 45 or above (10%).

For 42 respondents (84%), the entrepreneur's specialization was reported to be aligned with the venture's field of activity, whereas 8 respondents (16%) reported no such alignment. Eighteen ventures (36%) had one founder, 19 (38%) had two founders, 10 (20%) had three founders, 2 (4%) had four founders, and 1 (2%) had five founders.

The ventures operated across information and communication technology (20%), handicrafts (12%), services (28%), agriculture and food industries (6%), and other activities (34%). Regarding development stage, 27 ventures (54%) were in establishment or early operation, 18 (36%) were in growth and expansion, and 5 (10%) were described as stable in the market.

These characteristics are retained primarily to describe the sample. Group-difference tests are treated as secondary evidence because several subgroups are small.

Questionnaire and Measures

The original study used a structured questionnaire composed of three main parts.

The second questionnaire part measured competitive capabilities through 9 positively worded items covering innovation, quality improvement, cost reduction, market access, brand development, team skills,

Table 2: Internal-Consistency Coefficients

Scale / dimension	Items	Cronbach's α
Material resources	4	0.737
Human resources and consulting	4	0.708
Technical and financial support	4	0.720
Training and workshops	3	0.768
Communication and relationships	3	0.720
Overall incubator-service scale	18	0.902
Competitive-capabilities scale	9	0.922

Table 3: Analytical Strategy and Evidential Role

Analytical stage	Procedure	Main purpose	Evidential role / boundary
Descriptive analysis	Frequencies, percentages, means, SDs	Describe respondents, ventures, services, and competitive capabilities	Descriptive
Group comparisons	Independent-samples t tests, one-way ANOVA, normality/homogeneity checks	Compare competitive-capability scores across selected characteristics	Secondary, several subgroups are small
Primary association	Pearson correlation	Evaluate overall association and compare the five service dimensions	Principal evidence for RQ1 and RQ2, dimensions treated as one exploratory comparison family
Supplementary models	Linear regression, CHAID, radial-basis-function neural network	Describe alternative in-sample model representations	Supplementary only, no validated out-of-sample prediction

customer attraction and retention, market adaptation, and sustainable competitive advantage. The third part collected respondent and venture characteristics.

The questionnaire used a five-point Likert response scale. Construct-level weighted means were classified as low (1.00–2.33), moderate (2.34–3.67), or high (3.68–5.00), consistent with the original analytical protocol.

The questionnaire was developed with reference to scientific theories and prior studies and was reviewed by nine academic judges. Their comments were used to refine the instrument before final administration. Because the source materials do not provide a complete item-by-item mapping to previously published scales, the article does not claim that the questionnaire reproduces a specific established scale Table 1.

Reliability and Instrument Review

Internal consistency was assessed using Cronbach's alpha. Table 2 summarizes the reported coefficients.

These statistics are reported as evidence of internal consistency. The source study also presents a coefficient described as a validity coefficient, but no separate factor-analytic assessment of convergent, discriminant, or structural validity is reported. The article therefore makes the narrower claim that the scales displayed acceptable-to-high internal consistency in the study sample.

Analytical Strategy

The analyses were conducted using IBM SPSS Statistics version 31 and SPSS Modeler version 18.0. The article reports the analyses as originally performed and does not re-estimate the data.

The analytical strategy was organized around the study's two research questions, with supplementary analyses retained as secondary evidence (Table 3).

The linear-model analysis was initially specified as multiple linear regression, although the final reported specification retains communication and relationships as the only predictor. Because the variable-selection procedure is not documented, the article reports only the final model as presented and does not infer how the other candidate predictors were excluded.

The neural-network specification is a radial-basis-function network with one hidden layer containing 10 neurons. A Softmax activation function is reported for the hidden layer, while no output-layer activation function is reported. No independent holdout sample, cross-validation procedure, or clearly separated training and test performance is documented. The CHAID and neural-network results are therefore treated as supplementary in-sample model descriptions rather than as validated out-of-sample forecasting evidence.

Interpretation Boundaries

Several boundaries are maintained throughout the article.

First, the study is based on self-reported questionnaire responses and therefore measures respondents' perceptions of incubator services and competitive capabilities rather than independently audited organizational performance.

Second, the final sample comprises 50 observations distributed across 19 incubators. This multi-incubator coverage provides contextual diversity, but the sample size remains limited and does not support unrestricted generalization to all Algerian startups or all incubation programs.

Third, respondents are clustered within incubators, but no multilevel estimation or cluster-adjusted inference was reported. Observations from the same incubator may therefore share unobserved organizational conditions, so conventional p-values should not be interpreted as if the sampling structure were unquestionably independent.

Fourth, incubator services and competitive capabilities were reported by the same respondents in the same cross-sectional questionnaire. The design therefore cannot separate substantive covariance from possible common-source or response-style covariance.

Fifth, the cross-sectional design does not establish temporal ordering or causality. All coefficients are interpreted as associations.

Sixth, the article preserves the original statistical evidence without adding post hoc models, controls, robustness tests, or transformations that were not part of the original analysis.

Ethical Reporting Boundary

The available study documentation records questionnaire administration but does not report a formal institutional ethics-approval number or a detailed informed-consent protocol. Accordingly, no ethics-approval identifier or consent procedure is reported beyond what is documented in the source materials.

RESULTS

Sample Profile

Table 4 summarizes the demographic and venture characteristics of the final analytical sample (N = 50).

Reported Levels of Incubator Services and Competitive Capabilities

Table 5 summarizes the reported levels of the five incubator-service dimensions and the overall incubator-service measure.

The highest mean among the five service dimensions was reported for training and workshops (M = 4.34), followed by human resources and consulting (M = 4.25), material resources (M = 4.20), technical and financial

Table 4: Sample profile

Variable	Category	Number	Percentage
Incubator type	University	29	58
	Public	17	34
	Private	4	8
Gender	Female	26	52
	Male	24	48
Education	Licence/Bachelor's or Master's	39	78
	Postgraduate	8	16
	Secondary or below	3	6
Age	Under 25	10	20
	25–35	25	50
	36–44	10	20
	45 or above	5	10
Specialization–activity alignment	Yes	42	84
	No	8	16
Number of founders	1	18	36
	2	19	38
	3	10	20
	4	2	4
	5	1	2
Activity sector	ICT	10	20
	Handicrafts	6	12
	Services	14	28
	Agriculture and food industries	3	6
	Other	17	34
Venture stage	Establishment / early operation	27	54
	Growth / expansion	18	36
	Market stability	5	10

Table 5: Descriptive Statistics for Incubator-Service Dimensions

Dimension	Mean	SD	Interpretation
Material resources	4.20	0.281	High
Human resources and consulting	4.25	0.173	High
Technical and financial support	3.95	0.192	High
Training and workshops	4.34	0.100	High
Communication and relationships	3.94	0.194	High
Overall incubator services	4.14	0.238	High

Table 6: Competitive-Capability Item Means

Competitive-capability item	Mean
Offering innovative products or services	3.68
Developing team skills	3.62
Improving product or service quality	3.56
Building a strong brand	3.50
Achieving sustainable competitive advantage	3.44
Reducing operating costs	3.36
Accessing new markets	3.32
Adapting to market changes	3.32
Attracting and retaining customers	3.08
Overall competitive capabilities	3.43

support (M = 3.95), and communication and relationships (M = 3.94). The overall incubator-service score was 4.14 (SD = 0.238), which falls within the study's high range.

The competitive-capabilities measure produced an overall mean of 3.43 (SD = 0.184), which falls within the study's moderate range Table 6.

The overall competitive-capabilities score of 3.43 is therefore treated as moderate. Item-level reporting follows the numerical values shown in the original output tables.

Association Between Overall Incubator Services and Competitive Capabilities

Pearson's correlation analysis showed a positive association between the overall incubator-service measure and competitive capabilities, $r = 0.640$, $p<0.001$.

This result addresses the first research question by showing that higher reported levels of incubator services were associated with higher reported competitive capabilities within the observed sample. Because the study is cross-sectional, the coefficient is reported as an association rather than a causal effect.

Dimension-Specific Associations

Table 7 reports the Pearson correlations between each incubator-service dimension and competitive capabilities.

All five reported correlations were positive. Because the five dimension-specific tests form an exploratory comparison family and no multiplicity adjustment was part of the original analysis, interpretation focuses on the pattern and magnitude of the coefficients rather than on treating each p-value as an independent confirmatory discovery. The largest observed coefficient was for communication and relationships ($r = 0.648$), followed by technical and financial support ($r = 0.597$), training and workshops ($r = 0.580$), material resources ($r = 0.420$), and human resources and consulting ($r = 0.339$).

These coefficients provide the principal evidence for the second research question. They show that the magnitude of the observed association with competitive capabilities differed across the five service dimensions. No causal ranking is inferred from these bivariate correlations.

Secondary Group-Difference Tests

The analysis also tested whether competitive-capability scores differed across selected respondent and venture characteristics. These analyses are retained as secondary evidence because they are not central to the two research questions of the article.

Given the small size of several subgroups, these null results are reported as an absence of statistically detectable differences in the present sample rather than as evidence of population-level equivalence Table 8.

Supplementary Model-Based Analyses

The following models are retained only as secondary descriptive analyses. They are not required to answer RQ1 or RQ2 and are not used to establish causal importance or validated predictive performance.

Table 7: Correlations Between Incubator-Service Dimensions and Competitive Capabilities

Incubator-service dimension	Pearson's r	p-value
Material resources	0.420	0.002
Human resources and consulting	0.339	0.016
Technical and financial support	0.597	<0.001
Training and workshops	0.580	<0.001
Communication and relationships	0.648	<0.001

Table 8: Secondary Group-Difference Tests

Grouping variable	Test	Test statistic	p-value	Inference	Descriptive Group Means
Gender	Independent-samples t-test	t = -0.244	0.809	No statistically significant difference	Men 30.62 (SD 7.92), Women 31.11 (SD 6.26)
Educational level	One-way ANOVA	F = 0.164	0.849	No statistically significant difference	Secondary/below 28.66 (7.23), University 30.94 (7.03), Postgraduate 31.37 (7.83)
Age	One-way ANOVA	F = 0.469	0.705	No statistically significant difference	<25: 29.60 (3.80), 25–35: 32.08 (7.02), 36–44: 29.70 (9.93), 45+: 29.80 (6.22)
Specialization–activity alignment	Independent-samples t-test	t = -0.106	0.916	No statistically significant difference	Aligned vs not aligned, no statistically detectable difference
Venture development stage	One-way ANOVA	F = 2.030	0.143	No statistically significant difference	Establishment 29.44 (6.15), Growth 33.50 (8.10), Stable 29.20 (5.84)

Table 9: Supplementary Model Fit Statistics

Model	R	R^2	MAE	Maximum absolute error
Linear model	0.648	0.421	4.00	15.62
CHAID decision tree	0.726	0.527	3.92	9.43
Artificial neural network	0.737	0.534	4.07	9.25

Table 10: Supplementary Model Predictor Information

Model	Reported predictor information	Interpretive Boundary
Linear model	$Y = 7.955 + 1.936X_1$, X_1 = communication and relationships, t = 5.902, p < 0.001, F = 34.83, p < 0.001	Predictor-selection procedure not documented, supplementary only
CHAID	Communication and relationships 51%, Training and workshops 49%	Descriptive in-sample representation
Artificial neural network	Communication/relationships 24%, Material resources 21%, Training 19%, Technical/financial 18%, HR/consulting 18%, RBF network with 10 hidden neurons	No independent holdout or cross-validation, no predictive-superiority claim

The supplementary models show different in-sample fit profiles. The neural network reports the largest R^2 and smallest maximum absolute error, whereas CHAID reports the smallest MAE. Because no independent validation design is documented, these models add descriptive context rather than evidential weight, the article's primary conclusions remain anchored in the descriptive statistics and Pearson correlations Table 9-10.

DISCUSSION

Overall Support–Capability Pattern

The results reveal a clear distinction between the level of incubation support reported by respondents and the level of competitive capabilities observed in the same sample. Overall incubator services were rated highly (M = 4.14), whereas competitive capabilities were moderate (M = 3.43). At the same time, the two constructs were positively associated (r = 0.640, p<0.001). Considered together, these findings indicate that stronger reported incubation support is related to stronger reported competitive capabilities, but that a high level of service provision does not necessarily coincide with an equally high level of capability formation.

This distinction is important because incubation performance is often evaluated through the presence, range, or perceived quality of support services, whereas the development of competitive capabilities represents a different outcome. Recent meta-analytic evidence supports this separation. Seitz *et al.* [5] report a positive average relationship between incubator participation and new-venture performance but also substantial heterogeneity across programs and settings. Murillo-Rojas *et al.* [6] similarly show that incubation outcomes vary across innovation, growth, survival, profitability, and employment. The present evidence is consistent with this broader pattern: support inputs may be strong without generating uniformly strong outcomes across every capability dimension.

The item-level results help clarify this pattern. Respondents reported relatively stronger capability outcomes in areas such as innovation support and team-skill development, while weaker scores were observed for customer attraction and retention, access to new markets, and adaptation to market changes. These differences suggest that some internally oriented capabilities may have developed more strongly than outward-facing market capabilities. The data do not establish why this pattern occurs, but they indicate that the translation of incubator services into competitive capability is uneven rather than automatic.

A plausible interpretation is that service provision and capability development operate on different time horizons. Incubators can provide training, advice, infrastructure, technical assistance, and networking opportunities relatively quickly, whereas capabilities such as market adaptation, customer retention, and sustainable competitive positioning may require repeated application of those inputs over time. Because the study is cross-sectional, this temporal mechanism is not tested directly and should not be treated as an empirical finding. It nevertheless provides a theoretically coherent interpretation of the gap between high service provision and moderate competitive capability.
The overall association therefore supports a restrained conclusion: incubation services and competitive capabilities are meaningfully related in the observed sample, but the strength of capability formation depends on more than the volume or perceived quality of support alone. This interpretation is consistent with the growing view that incubation should be evaluated through differentiated mechanisms and outcomes rather than through a single aggregate measure of program success.

Heterogeneity Across Incubator-Service Dimensions

The most informative result is that the five dimensions of incubation support display a heterogeneous pattern of associations with competitive capabilities. Communication and relationships produced the strongest observed correlation ($r = 0.648$), followed by technical and financial support ($r = 0.597$), training and workshops ($r = 0.580$), material resources ($r = 0.420$), and human resources and consulting ($r = 0.339$). All five relationships were positive. Because these dimension-specific tests were not adjusted for multiplicity, the stronger inference concerns the overall pattern of coefficient magnitudes rather than five separate confirmatory significance claims. In particular, the relatively close coefficients for technical and financial support (0.597) and training and workshops (0.580) should not be over-interpreted as a precise rank ordering.

The prominence of communication and relationships is consistent with research that conceptualizes incubators as network intermediaries rather than merely as providers of workspace or administrative services. Earlier work by Hughes *et al.* [18], Fang *et al.* [17], and Redondo and Camarero [25] similarly emphasizes the role of social capital, learning, and external bridging ties in incubation. Wu *et al.* [9], using data from 205 ventures in Chinese incubators, report positive relationships between incubator networks and new-venture performance, with entrepreneurial orientation and environmental dynamism shaping those relationships. Van Rijnsoever [8] similarly emphasizes the intermediary role of incubators in overcoming weak-network problems within entrepreneurial ecosystems. Kiran and Bose [26] also identify networking as an important predictor of technology-business-incubator performance.

These studies provide a strong comparative basis for interpreting the Algerian result. The communication and relationships dimension includes access to potential investors, relationships with other firms, and opportunities to present ventures to external audiences. In emerging entrepreneurial environments, such connections may be particularly valuable because young ventures often lack established market positions, reputational capital, or direct access to resource holders. Relational support can therefore expand access to information, legitimacy, expertise, funding opportunities, and market contacts that may be difficult to generate internally.

At the same time, the network result should not be generalized beyond the evidence. Sullivan *et al.* [10] show that network ties do not improve all learning-performance relationships uniformly, their value depends on the learning domain and the type of tie involved. The present finding therefore supports the conclusion that relational support was especially salient in this sample, not that networking is universally the most effective incubation mechanism.

The second-largest association concerned technical and financial support. This dimension combines assistance with technology and specialized knowledge together with access to funding opportunities and information on available financial sources. Ahmed *et al.* [22] similarly report positive relationships between capital support, networking services, training programs, and sustainable entrepreneurship growth. However, the combined structure of this measure requires a narrower interpretation. The observed coefficient cannot be attributed to finance alone or to technical assistance alone, it reflects the joint dimension as measured in the study.

Training and workshops also showed a substantial association with competitive capabilities. This finding is compatible with research that treats incubation as a learning process as well as a resource-provision mechanism. Asensio-Ciria *et al.* [21] emphasize counseling, channels, and training within the structure of incubation processes, while

De-Pablos-Heredero and Blanco Jiménez [20] show that accelerator practices can contribute differently to capability development and startup performance. Although those studies employ constructs that are not identical to the competitive-capability measure used here, they support the broader interpretation that structured learning activities can form part of capability-building processes.

The contrast between the training result and the overall capability level is also informative. Training and workshops received the highest service mean (M = 4.34), yet competitive capabilities remained moderate overall. This suggests that a high reported level of training does not by itself guarantee equivalent capability outcomes. One implication is that the relevance, specificity, and application of training may matter as much as its availability. In the present sample, comparatively lower capability scores in customer attraction, market access, and adaptation suggest that market-oriented training may warrant particular attention.

Material resources were positively associated with competitive capabilities but less strongly than communication, technical-financial support, and training. This pattern also fits the distinction made in earlier service-based work between infrastructure and more interactive support mechanisms [11,26]. This finding is consistent with the broader distinction between enabling infrastructure and more interactive forms of support. Wang *et al.* [3] show that different incubator capacities have unequal relationships with innovation performance, while Woolley and MacGregor [4] find that venture-development program effects vary substantially across program types and service configurations. Physical resources may therefore be necessary to reduce operating constraints without being sufficient to produce stronger competitive development on their own.

Human resources and consulting generated the smallest of the five significant correlations, despite being rated highly in descriptive terms. This result should not be interpreted as evidence that consulting is ineffective. Rather, it shows that advisory support had the weakest observed bivariate relationship with competitive capabilities among the five dimensions measured. Advisory services can vary in relevance, customization, timing, and implementation, and their value may depend on whether ventures are able to translate advice into action. The study does not test these mechanisms directly, so the result is best interpreted as a relative difference in association rather than a judgment about the intrinsic usefulness of consulting.

Taken together, the dimension-specific evidence supports a portfolio view of incubation. The findings do not imply that one service should replace another. All five dimensions were positively associated with competitive capabilities. The more defensible conclusion is that interactive, relational, technical-financial, and learning-oriented support displayed stronger observed links with competitive capabilities than material infrastructure and consulting in this sample. This pattern is consistent with the wider literature showing that program design, service composition, and outcome choice shape the effectiveness of incubation.

Convergence, Boundaries, and Substantive Meaning

The secondary analyses and supplementary models provide useful context but do not change the hierarchy of evidence. No statistically significant differences were detected in competitive-capability scores by gender, educational level, age, specialization–activity alignment, or venture-development stage. These findings indicate that no clear differences were detectable across these categories within the observed sample. They should not be interpreted as proof that the groups are equivalent in the wider population, particularly because several subgroups are small.

The development-stage results illustrate this boundary. Ventures in growth and expansion reported a higher mean competitive-capability score than ventures in establishment/early operation or market stability, but the overall ANOVA was not statistically significant. With only five observations in the market-stability group, the study does not provide strong evidence for or against stage-related differences. The group tests are therefore appropriately treated as secondary descriptive evidence rather than as a separate contribution.

The supplementary model-based analyses provide only descriptive convergence with the bivariate results. Communication and relationships recurs prominently across the reported linear, CHAID, and neural-network representations, but the sample is too small and no independent validation design is documented. These models therefore add context rather than evidential weight. The article's substantive interpretation remains anchored in the descriptive statistics and Pearson correlations that directly answer the research questions.

Two design features also constrain how these associations should be interpreted. First, incubator services and competitive capabilities were reported by the same respondents in the same survey, so common-source covariance cannot be separated from the substantive relationship. Second, respondents are nested within 19 incubators, yet the reported inference does not adjust for within-incubator dependence. These limitations do not negate the observed coefficient pattern, but they reduce the strength of claims that can be made from exact p-values or from differences between nearby correlations.

At a broader level, the results support three substantive conclusions. First, business incubation should be treated as a heterogeneous support system rather than a single intervention. The five service dimensions exhibit different relationships with the same outcome, reinforcing recent evidence that incubation effects depend on program design, support mechanism, and context. Second, relational support appears particularly salient in the observed Algerian setting, consistent with research emphasizing the network-intermediation role of incubators. Third, the coexistence of high service ratings with moderate competitive capabilities cautions against evaluating incubation success solely through service-delivery indicators.

The study therefore contributes a more differentiated view of incubation in which the relevant question is not simply whether support exists, but how distinct forms of support are associated with the capabilities that incubated ventures need to compete. The evidence remains bounded by the cross-sectional, self-reported design and the modest sample size, but within those limits it provides a coherent account of how service composition relates to competitive capability in an emerging incubation environment.

Practical Implications

The findings have several implications for incubator managers, public support agencies, universities, and organizations involved in startup development in Algeria.

First, the results suggest that incubator performance should not be assessed only through the availability or perceived quality of services. Respondents reported a high overall level of incubator services, while competitive capabilities remained moderate. This pattern indicates that service-delivery indicators alone may provide an incomplete picture of whether incubation is translating into venture-level development. Evaluation systems may therefore benefit from incorporating indicators related to capability formation, such as market access, customer acquisition and retention, adaptation to market changes, product or service improvement, and the development of sustainable competitive positions.

Second, the strong association observed for communication and relationships points to the importance of strengthening the intermediary role of incubators. Programs that connect startups with investors, customers, established firms, experts, universities, public institutions, and peer entrepreneurs may help ventures gain access to information and opportunities that are difficult to obtain internally. For incubator managers, this means that networking activities can be treated as structured support mechanisms rather than as occasional events. Investor meetings, business-matching activities, sector-specific networking, demonstration events, and links with external mentors can be integrated more systematically into incubation programs.

Third, technical and financial support may be more appropriately viewed as a combined developmental function than as a narrow funding function. The corresponding study dimension includes both access to technological or specialized knowledge and assistance related to financing opportunities. Incubators may therefore obtain greater value by integrating financial guidance with technical assessment, technology access, and business-development support rather than offering these services independently.

Fourth, the strong association between training and workshops and competitive capabilities suggests that learning-oriented services remain important. However, the moderate overall level of competitive capabilities implies that training should be evaluated in terms of application and relevance, not only frequency or participant satisfaction. In particular, comparatively weaker capability scores related to customer retention, market access, and market adaptation suggest that training portfolios may benefit from a stronger market-development orientation.

Finally, the weaker observed associations for material resources and human resources/consulting do not imply that these services are unnecessary. Physical infrastructure remains an enabling condition, while consulting can provide specialized knowledge. The results instead suggest that these services may create greater value when integrated with relational, technical-financial, and learning-oriented support. A portfolio approach to incubation is therefore preferable to a model centered on a single category of assistance.

Limitations and Future Research

The findings should be interpreted within several methodological and empirical limitations.

The study is based on a cross-sectional survey, which limits the ability to establish temporal ordering between incubation services and competitive capabilities. The positive associations reported in the study cannot therefore be interpreted as causal effects. Longitudinal designs would provide stronger evidence by examining whether changes in exposure to incubation services precede changes in competitive capabilities over time.

A second and more direct limitation concerns common-source measurement. Incubator services and competitive capabilities were assessed through the same questionnaire and the same respondent. The observed correlations may

therefore combine substantive relationships with shared response tendencies, halo effects, or consistency motifs. The study does not include an independent outcome source or a dedicated common-method design, so the magnitude of this contribution cannot be quantified from the available evidence. Future research should combine entrepreneur reports with objective venture outcomes, administrative records, or ratings from additional informants.

The measurement evidence also supports internal consistency rather than full construct validity. Cronbach's alpha is high for the overall scales, but no factor-analytic evidence is available to establish the separability of all five service dimensions or the unidimensionality of the broad competitive-capability construct. The present study therefore supports dimension-level descriptive comparison rather than strong latent-construct claims. Future work should validate the measurement structure explicitly before testing structural relationships.

The final analytical sample consists of 50 respondents associated with 19 incubators. The multi-incubator coverage introduces useful contextual diversity, but the sample remains modest and several subgroup analyses involve small cells. In addition, the reported analyses do not adjust for the nesting of respondents within incubators. If ventures from the same incubator share unobserved organizational conditions, conventional standard errors and p-values may understate dependence. The results therefore should not be generalized without caution to all Algerian startups or all incubation programs. Future studies could employ larger multi-incubator samples and, where the data structure permits, use multilevel or cluster-aware inference.

The study relies on self-reported measures of both incubation services and competitive capabilities. This design captures the perceptions of entrepreneurs and project owners but does not independently verify firm performance. Future research could complement perceptual measures with objective indicators such as revenue growth, employment, innovation outputs, customer acquisition, market expansion, financing obtained, survival, or graduation from incubation.

The measurement structure also places some conceptually distinct forms of support within the same dimension. In particular, technical and financial support are combined. As a result, the present data do not allow their separate associations with competitive capabilities to be identified. Future studies could disaggregate these forms of assistance and examine whether technical expertise, technology access, financing information, and actual financial access operate differently.

Similarly, the communication and relationships dimension captures several relational functions, including contact with investors, relationships with firms, and public presentation opportunities. Because this dimension produced the strongest observed association, future research could distinguish among different types of ties and examine which connections are most relevant at different stages of venture development.

The five dimension-specific correlations also form a related family of exploratory comparisons. No multiplicity adjustment was part of the original analysis, so the pattern of coefficient magnitudes is more informative than treating each p-value as an independent confirmatory result. Future studies could pre-specify primary comparisons or use an appropriate familywise or false-discovery procedure where confirmatory inference is intended.

The supplementary linear, CHAID, and neural-network models provide useful descriptive convergence, but no clearly independent holdout sample was reported or cross-validation design. Their comparative fit therefore should not be treated as established out-of-sample predictive performance. Future research using larger samples could evaluate these models with explicit training, validation, and test partitions or repeated cross-validation.

Finally, the study does not test the mechanisms through which incubator services may be related to competitive capabilities. The present interpretation draws on prior literature suggesting roles for learning, resource access, network intermediation, and capability development, but these mechanisms were not estimated as mediators. Future research could test such pathways directly and investigate whether their importance varies across incubator type, venture stage, sector, or institutional setting.

CONCLUSION

This study examined the relationship between business-incubator services and the competitive capabilities of incubated startups in Algeria using survey evidence from 50 respondents associated with 19 business incubators. Rather than treating incubation as a single intervention, the analysis distinguished five service dimensions: material resources, human resources and consulting, technical and financial support, training and workshops, and communication and relationships.

The findings show that respondents reported a high overall level of incubator services, while competitive capabilities remained moderate. At the same time, the overall incubator-service measure was positively associated with competitive capabilities. This combination highlights an important distinction between the provision of support and the development of venture capabilities: strong service provision does not necessarily translate into equally strong competitive capability.

The dimension-specific results provide the central contribution of the study. All five service dimensions were positively associated with competitive capabilities, but the magnitudes differed. Communication and relationships showed the largest observed coefficient, while technical and financial support and training and workshops also showed comparatively strong associations. Material resources and human resources/consulting remained positively associated with competitive capabilities but displayed smaller correlations.

These findings support a differentiated view of business incubation. Incubators appear to function not only as providers of infrastructure or administrative assistance but also as relational, learning, and resource-access intermediaries. In the observed Algerian sample, the strongest associations were linked to support that connects ventures with external actors, specialized resources, and learning opportunities.

The study does not establish causal effects, and its conclusions remain bounded by the cross-sectional design, modest sample size, and self-reported measures. Nevertheless, the evidence contributes to a more precise understanding of incubation by showing that service composition matters and that the different components of support should not be assumed to relate equally to competitive capability.

For practice, the results suggest that incubator evaluation should move beyond counting services or measuring participant satisfaction alone. Greater attention should be given to whether support contributes to venture-level capabilities, particularly in areas related to market access, customers, adaptation, innovation, and competitive positioning. For research, the results provide a basis for larger and longitudinal studies that can examine how distinct incubation mechanisms translate into capability development across different entrepreneurial ecosystems.

Overall, the study shifts the emphasis from the broad question of whether business incubators support startups to the more specific question of how different forms of support are associated with the capabilities ventures need to compete.

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