



Connected Technology as a Service (CTaaS) Bridging the Small Businesses and Large Enterprises' Digital Divide

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ABSTRACT: Small businesses constitute 99.9% of all U.S. enterprises, employ 45.9% of the private-sector workforce, and generate 43.5% of national GDP, yet they consistently lag large enterprises in adopting, affording, and sustaining digital technology. This persistent gap across cloud computing, artificial intelligence (AI), cybersecurity, and integrated business platforms directly reduces operational efficiency, weakens resilience, and diminishes competitiveness. Critically, the gap is not primarily one of awareness or willingness: it is a resource gap. Small businesses lack the capital to acquire enterprise-grade technology, the technical staff to deploy and maintain it, and the budget cycles to upgrade it as it ages. The result is a compounding disadvantage that widens with each technology generation. This article examines the structural drivers of the small-business technology adoption gap across the full spectrum of American small businesses, from retail, food service, and professional services to construction, healthcare, and home-based enterprises. It introduces Connected Technology as a Service (CTaaS) as the resource backbone small businesses have never had: a unified, subscription-based, vendor-managed service layer that packages cloud infrastructure, IoT connectivity, AI-driven analytics, cybersecurity, and workflow automation into a single operating environment, acquired, deployed, and continuously upgraded without requiring capital expenditure, technical expertise, or internal IT capacity. A six-layer CTaaS architecture, a sector-applicability matrix, a pain-point resolution model, a cost-capability comparison, and a phased adoption roadmap toward competitive parity are presented, supported by current market and survey data.

KEYWORDS: Artificial intelligence, business equity, cloud computing, Connected Technology as a Service (CTaaS), cybersecurity, digital divide, Internet of Things, resource backbone, small and medium enterprises (SMEs), Software as a Service (SaaS), technology adoption, technology upgrade cycle, XaaS.

I. INTRODUCTION

Small businesses are not a peripheral segment of the American economy; they are its foundation. As of 2024, the U.S. Small Business Administration reports that 36.2 million small businesses operate in the United States, representing 99.9% of all firms, employing 62.3 million people (45.9% of the private-sector workforce), and contributing 43.5% of gross domestic product [1], [2]. Between March 2023 and March 2024, small businesses accounted for 88.9% of net new private-sector job growth [2]. By any economic measure, the health of the small business sector is the health of the American economy.

Yet this sector faces a persistent, measurable technological disadvantage. Despite the near-universal use of at least one digital platform, small businesses remain a step behind large enterprises across nearly every category of advanced technology, including cloud infrastructure, artificial intelligence, integrated enterprise platforms, and cybersecurity [3], [4], [5]. The gap is not simply one of access; it is a compounding gap in affordability, technical know-how, and sustained use, each of which independently erodes the competitiveness of small operators relative to medium and large players [5], [6].

At the heart of this disadvantage lies a single, inescapable reality: small businesses lack the resources to acquire and deploy effective technology in the first place, and even when they do, they lack the resources to maintain, secure, and upgrade it as technology evolves. This is not a story about small businesses being unwilling to adopt technology. Surveys consistently show strong intent [7]. It is a story about a resource gap so structural and persistent that it constitutes a systemic market failure.

This article argues that the small-business technology gap is not an inevitability of scale but a solvable market-structure problem. It introduces Connected Technology as a Service (CTaaS) a unifying framework that delivers cloud computing,



IoT connectivity, AI-driven analytics, cybersecurity, and core business workflows as a single, subscription-based, vendor-managed service. CTaaS is positioned as the external resource backbone small businesses have never had access to: a mechanism through which any small business, regardless of sector, size, or technical capacity, can acquire, deploy, and continuously benefit from enterprise-grade digital capabilities without enterprise-grade capital, staffing, or technical overhead.

The remainder of this article is organized as follows. Section II outlines the size and sectoral composition of the U.S. small-business landscape. Section III quantifies the technology adoption gap using current survey data (Fig. 1). Section IV examines the structural barriers underlying this gap. Section V introduces the CTaaS framework and its six-layer architecture (Fig. 2). Section VI maps the applicability of CTaaS across major small-business sectors (Table I). Section VII presents a pain-point resolution model (Fig. 3), and Section VIII presents a phased adoption roadmap toward competitive parity (Fig. 4, Table II). Section IX discusses broader implications, and Section X concludes.

II. THE U.S. SMALL BUSINESS LANDSCAPE

A. Economic Scale and Contribution

The SBA defines a small business as any firm with fewer than 500 employees, ranging from sole proprietors and freelancers to firms with several hundred employees [1]. Of the 36.2 million small businesses operating in 2024, approximately 33.2 million are non-employer firms, sole proprietors and independent contractors while roughly 3 million are employer firms with payrolls [1], [10]. Collectively, small businesses generated an estimated \$13.3 trillion in gross revenue and accounted for 39% of all private-sector payroll [2], [7]. Small firms also accounted for 32.6% of identified U.S. export value and 97.2% of all exporting companies [8].

B. Sectoral Composition

Small businesses are found across nearly every sector of the economy, but several categories dominate by firm count. Professional, scientific, and technical services are the largest category, with approximately 4.53 million small businesses (13.6% of the total), followed by construction at roughly 3.62 million (10.9%) [8]. Food and restaurant services and general business services are among the fastest-growing small business categories, with health, beauty, and fitness services, general retail, and home services also showing consistent growth [3], [8]. Retail trade alone accounts for roughly 2.89 million small businesses [8]. In several sectors construction, other services, and professional/technical services small firms represent more than 99% of all employer establishments and over 75% of sector employment [10], underscoring that, for many industries, "small business" and "the industry" are nearly synonymous.

This sectoral diversity matters directly for technology strategy. A framework intended to close the small-business technology gap cannot be designed around the needs of a single vertical, it must be modular enough to serve a home-care agency, a specialty retailer, a construction subcontractor, and a professional services firm with equal relevance, a requirement addressed directly by the CTaaS architecture introduced in Section V.

III. THE TECHNOLOGY ADOPTION GAP

The gap between small-business and enterprise technology adoption is well documented across multiple independent data sources and spans cost, capability maturity, and continued use. Fig. 1 summarizes six representative domains.

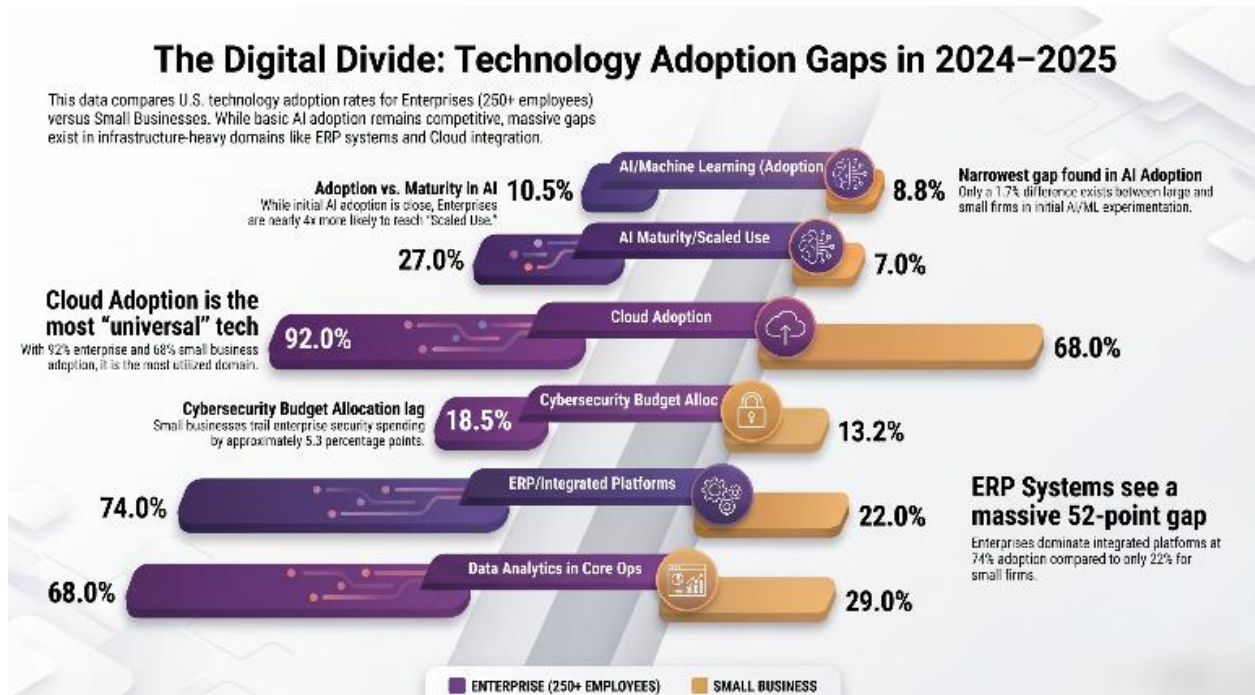


Fig. 1. The digital divide: technology adoption gaps between U.S. enterprises (250+ employees) and small businesses, 2024–2025.

A. AI Adoption: A Narrowing but Real Gap

In February 2024, large businesses used AI at 1.8 times the rate of small businesses (11.1% versus 6.3%) [5]. By August 2025, small-business AI usage had risen to 8.8%, while large-business adoption held near 10.5% a meaningfully narrower gap than in prior technology cycles [5]. However, the more revealing metric is maturity: while 60% of small businesses report using AI tools in some capacity, large enterprises achieve scaled, mature deployment at a rate nearly four times that of small firms [5], [6]. Among SMEs that do use generative AI, only 29% apply it to core business activities, with the remainder confined to peripheral tasks such as marketing content [6].

B. Cloud, ERP, and Analytics

Cloud adoption shows one of the narrower gaps roughly 68% of SMBs versus 92% of enterprises reflecting the success of consumer-friendly SaaS onboarding [4], [9]. The widest gap appears in integrated enterprise resource planning (ERP) and similarly comprehensive platforms, where small-business adoption (22%) trails enterprise adoption (74%) by 52 percentage points [4], [9]. Data analytics embedded in core operations shows a similar pattern: 29% of small businesses versus 68% of enterprises [4], [6]. These two metrics ERP and analytics are arguably the most consequential because they represent not point tools but operating-system-level capabilities that touch every business function simultaneously.

C. Cybersecurity: The Most Asymmetric Risk

Cybersecurity presents the starkest risk asymmetry. Small businesses allocate a substantially smaller share of their IT budgets to cybersecurity than larger organizations [11], [12]. More starkly, 47% of businesses with fewer than 50 employees report having no cybersecurity budget at all, and 51% have no security measures in place [14]. The consequences are measurable: 88% of SMB breaches in 2025 involved ransomware, compared with 39% for larger organizations [12]. The global average cost of a data breach reached \$4.88 million in 2024 a 10% year-over-year increase [12] a sum that would be existential for the vast majority of small operators.

IV. STRUCTURAL BARRIERS TO ADOPTION

The persistence of the adoption gap is best explained not by a single cause but by four well-documented, compounding structural barriers plus a fifth that receives far less attention in the literature: the technology upgrade trap.



A. Capital and Cost Constraints

Approximately 45% of SMBs cite budget constraints as a significant barrier to expanding IT capabilities, and the cost burden is proportionally regressive: small businesses spend an average of 6.9% of revenue on IT, compared with 4.3% for enterprises a higher "technology tax" on smaller firms despite their lower absolute spending power [9]. Enterprise-grade ERP, analytics, and cybersecurity platforms have historically required capital investments in the tens to hundreds of thousands of dollars, a threshold simply unreachable for the median small business, 81.9% of which operate as non-employer firms with no payroll infrastructure [7].

B. Technical Know-How and Workforce Gaps

Lack of internal expertise is now cited as the primary barrier to adopting new technology by 56% of SMBs ahead of budget constraints (41%) and integration complexity (38%) [9]. The OECD finds that self-employed entrepreneurs address technology skills gaps primarily by relying on personal networks (31% of cases), while small and medium firms reassign existing staff (44–46% of cases) rather than hiring dedicated technical personnel [6]. Notably, 82% of the smallest firms (under five employees) cite the belief that AI or advanced technology is simply "not applicable" to their business as their primary reason for non-adoption a finding researchers interpret as an education and awareness gap rather than a genuine applicability gap [5].

C. Cybersecurity and Compliance Exposure

As detailed in Section III-C, small businesses face a structurally higher risk-to-resource ratio in cybersecurity. Only 51% of SMBs have implemented security policies for AI and generative AI tools, leaving a substantial population exposed to data leakage and misuse risks as they begin experimenting with AI without corresponding governance [13]. The average cost to recover from a malware attack rose to \$2.73 million in 2024, up from \$1.82 million in 2023 [12] a sum that would be existential for the vast majority of small operators.

D. Platform Fragmentation and Integration Complexity

Even when small businesses adopt individual tools, those tools often operate as disconnected point solutions a scheduling app, a separate accounting platform, a standalone point-of-sale system none of which exchange data natively. This fragmentation forces manual re-entry, creates data silos, and prevents the cross-functional analytics that larger firms use to drive efficiency. Academic literature on SME digital transformation consistently identifies this integration burden as a distinct barrier, separate from cost or skills alone, and observes that SMEs unable to respond to disruptive digital innovations risk losing market share even when individual technology components are present but disconnected [15], [16].

**Table I
Structural Barriers to Technology Adoption**

Structural Barrier	Key Metric	Core Impact
A. Capital & Cost	SMBs pay 6.9% of revenue on IT vs. 4.3% for enterprises.	A regressive "technology tax" makes high-end platforms financially unreachable.
B. Workforce & Expertise	56% cite lack of internal expertise as their top barrier.	Relying on networks or reassigning staff creates an awareness/skills gap.
C. Cyber & Compliance	Malware recovery costs hit \$2.73M; only 51% have AI policies.	High risk-to-resource ratio; cyberattacks pose an existential threat.
D. Platform Fragmentation	Disconnected tools prevent cross-functional analytics.	Fragmented point solutions create data silos and force manual re-entry.



E. The Technology Upgrade Trap: The Hidden Resource Drain

A fifth structural barrier receives far less attention in the literature but may be the most practically damaging: the technology upgrade trap. Small businesses that successfully acquire and deploy technology overcoming the capital and expertise hurdles often find themselves stranded as that technology ages. Consumer-grade devices lose up to 40% of their functionality within 12 months. Business software platforms release major version updates on cycles that can require costly re-platforming projects every three to five years. Security vulnerabilities emerge continuously in unpatched systems, and compliance frameworks evolve in ways outdated platforms cannot accommodate.

For a large enterprise, a technology refresh is a planned capital event managed by a dedicated IT department. For a small business, it is a crisis. The owner who spent six months selecting and deploying a scheduling and billing platform in year one faces a painful choice in year three: absorb the disruption and cost of migrating to a newer system, or continue running on aging infrastructure that is increasingly insecure and increasingly invisible to the analytics competitors use to gain efficiency advantages. This upgrade trap is structurally distinct from the initial acquisition barrier and is structurally invisible in most survey-based research because it affects businesses that have already adopted technology. It nonetheless represents one of the most significant ongoing resource drains on small business technology capability and it is the barrier that CTaaS is perhaps uniquely positioned to eliminate, because continuous platform currency is embedded in the subscription model by default.

V. CTAAS: A CONCEPTUAL FRAMEWORK

A. Definition and Core Principles

Connected Technology as a Service (CTaaS) is defined here as an integrated, subscription-based, vendor-managed service layer that combines connectivity (IoT and networking), cloud infrastructure, AI-driven analytics, cybersecurity, and core business applications into a single operating environment—delivered to small businesses as a single, coherent service rather than as a collection of independently procured tools. CTaaS extends the well-established "XaaS" (Anything-as-a-Service) paradigm which already encompasses SaaS, PaaS, IaaS, and dozens of specialized variants [17]–[19] by explicitly designing the service bundle, pricing model, and support structure around the resource constraints identified in Section IV, rather than treating small businesses as a downstream market for enterprise products.

Three principles distinguish CTaaS from generic XaaS adoption. First, unification: rather than small businesses individually selecting, procuring, and integrating a scheduling tool, a CRM, an analytics dashboard, and a security suite from different vendors, CTaaS delivers these as pre-integrated modules within a single architecture. Second, managed complexity: the service provider handles technical configuration, security hardening, compliance management, and ongoing maintenance, directly addressing the 56% expertise gap identified in Section IV-B [9]. Third, elastic, usage-aligned pricing: CTaaS pricing scales with business size and usage rather than requiring fixed capital outlays, converting technology from a capital expenditure into an operating expense [9], [20].

B. CTaaS as the Resource Backbone

To understand CTaaS's role clearly, it helps to frame it not just as a technology service but as a resource backbone. When a large enterprise builds its technology stack, it deploys three types of resources most small businesses simply do not have: **capital** (to purchase enterprise software licenses, hardware, and integration services), **human expertise** (to configure, secure, and maintain those systems), and **operational continuity** (the ability to manage an ongoing upgrade cycle without disrupting day-to-day operations). These three resources are the reason the technology gap exists and persists across successive technology generations from broadband to cloud to AI.

CTaaS substitutes for all three. Capital is replaced by a **predictable monthly subscription** that requires **no upfront investment** and **scales with the size of the business**. Human expertise is replaced by the provider's **managed-service capability** the entire technical layer, from initial configuration to ongoing security patching to compliance management, is handled externally. And operational continuity is replaced by the **subscription model's inherent guarantee of platform currency**: because the provider's business model depends on delivering a current, functional service, the small business is automatically protected from the technology upgrade trap described in Section IV-E.

This is what makes CTaaS genuinely different from simply signing up for a collection of SaaS tools. A small business that subscribes to five separate SaaS products still faces the integration problem, the security configuration problem, the expertise gap when something breaks, and the upgrade trap when one of those products changes its pricing model or discontinues a feature. **CTaaS solves all five structural barriers** simultaneously, within a single vendor relationship, under a single subscription.



C. Six-Layer CTaaS Architecture

Fig. 2 presents the proposed CTaaS architecture as six functional layers, spanning from physical sensing to the human stakeholders the system ultimately serves. **Layer 1 (Physical Devices and Sensor)** comprises IoT devices, wearables, point-of-sale terminals, and edge gateways that a small business uses to capture real-world data. **Layer 2 (Connectivity and Network)** provides the secure transport fabric 5G/LTE, Wi-Fi 6, VPN tunnels, and API gateways that connects Layer 1 devices to the cloud without requiring on-premise networking expertise. **Layer 3 (Cloud Platform)** is the computational core: data lakes, AI/ML analytics engines, workflow automation, and compliance-ready hosting, all provisioned and maintained by the CTaaS provider. **Layer 4 (Applications)** delivers day-to-day business functions—scheduling, billing, customer relationship management, and service-specific tools—as pre-integrated modules that draw on the same underlying data layer. **Layer 5 (Insight and Decision)** surfaces real-time alerts, KPI dashboards, predictive risk scoring, and compliance reporting, all derived automatically from the data flowing through Layers 1–4. **Layer 6 (User and Stakeholder)** is the human interface layer—business owners, field employees, customers, and external partners each access the same underlying system through role-appropriate views.

CTaaS Framework: Connected Technology as a Service Architecture

End-to-end service model delivering enterprise-grade capability to small businesses at SMB-scale cost.

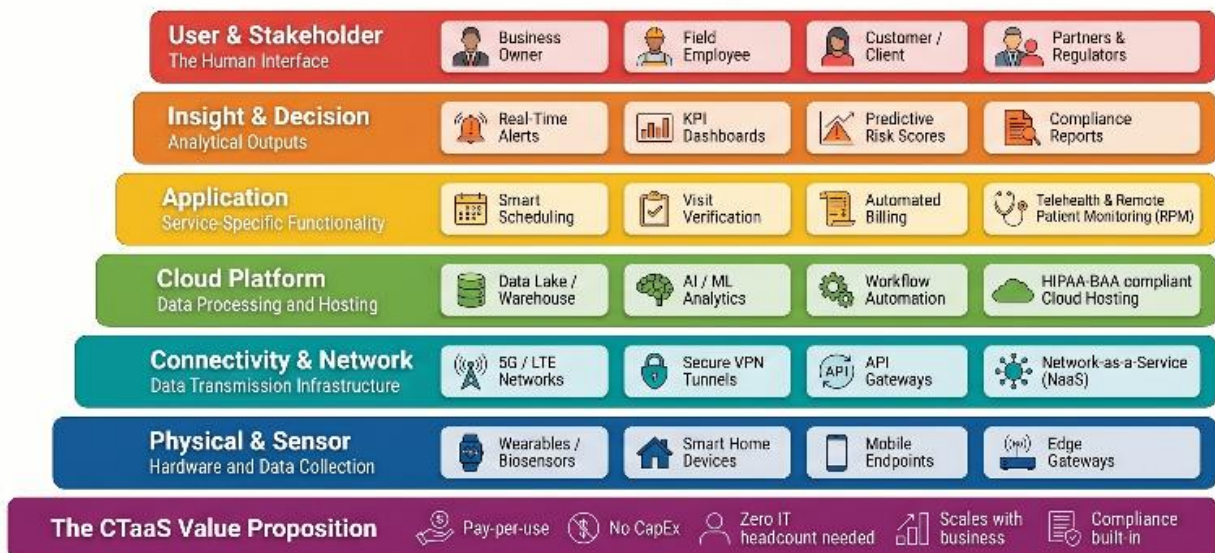


Fig. 2. The six-layer CTaaS architecture, delivering enterprise-grade capability to small businesses at SMB-scale cost.

The critical architectural feature is that all six layers are delivered, billed, and supported as a single service. A small business does not separately purchase IoT hardware, contract with a network provider, lease cloud infrastructure, license analytics software, or hire integration consultants. It subscribes to CTaaS and receives the entire stack, pre-connected, pre-secured, and pre-configured for its operations.

VI. CTAAS APPLICABILITY ACROSS SMALL BUSINESS SECTORS

Because CTaaS is modular by design, the **same six-layer architecture can be configured to serve substantially different small-business categories by activating different Layer 4 applications and Layer 1 devices and sensors, while Layers 2, 3, 5, and 6 remain largely constant.** Table II illustrates this applicability across six representative sectors that together account for the vast majority of U.S. small businesses by firm count [8], [10]. Across all sectors, the underlying CTaaS infrastructure secure connectivity, cloud hosting, AI analytics, and compliance management remains constant, while the customer-facing modules in Layer 4 are sector-specific. This architecture enables CTaaS to achieve both breadth (applicability across all categories of American small businesses) and depth (sector-relevant functionality) without requiring each business to solve the underlying infrastructure problem independently.



Table II
CTaaS Sector-Applicability Matrix Across Representative U.S. Small Business Categories

Sector	Representative Layer 1 Devices & Sensors	Sector-Specific Layer 4 Applications	Primary CTaaS Benefit
Retail Trade	POS terminals, RFID, foot-traffic sensors	Inventory, POS, e-commerce, loyalty CRM	Unified omnichannel sales and inventory analytics
Food & Restaurant	Kitchen IoT, temperature probes, POS	Ordering, reservations, delivery integration	Demand forecasting; food-safety compliance
Construction	Equipment trackers, site sensors, wearables	Project mgmt, bidding, scheduling, safety logs	Asset tracking; jobsite safety and compliance
Professional Services	Mobile endpoints, edge gateways	CRM, billing, document mgmt, time tracking	Automated billing; client analytics
Health & Home Care	Wearables, RPM devices, EVV mobile	Scheduling, EVV, telehealth, compliance	HIPAA-compliant care delivery and verification
Personal & Beauty Services	Mobile POS, booking kiosks	Appointment booking, payments, marketing	No-show reduction; client retention analytics

VII. PAIN-POINT RESOLUTION MODEL

Section IV identified **five structural barriers capital, technical know-how, cybersecurity, integration, and the technology upgrade trap** to which a sixth, **scalability**, can be added: small businesses that do adopt point-solution technology often find themselves locked at their current operational scale because legacy tools cannot expand without a costly re-platforming exercise. Fig. 3 maps each of these barriers directly to the corresponding CTaaS architectural response.

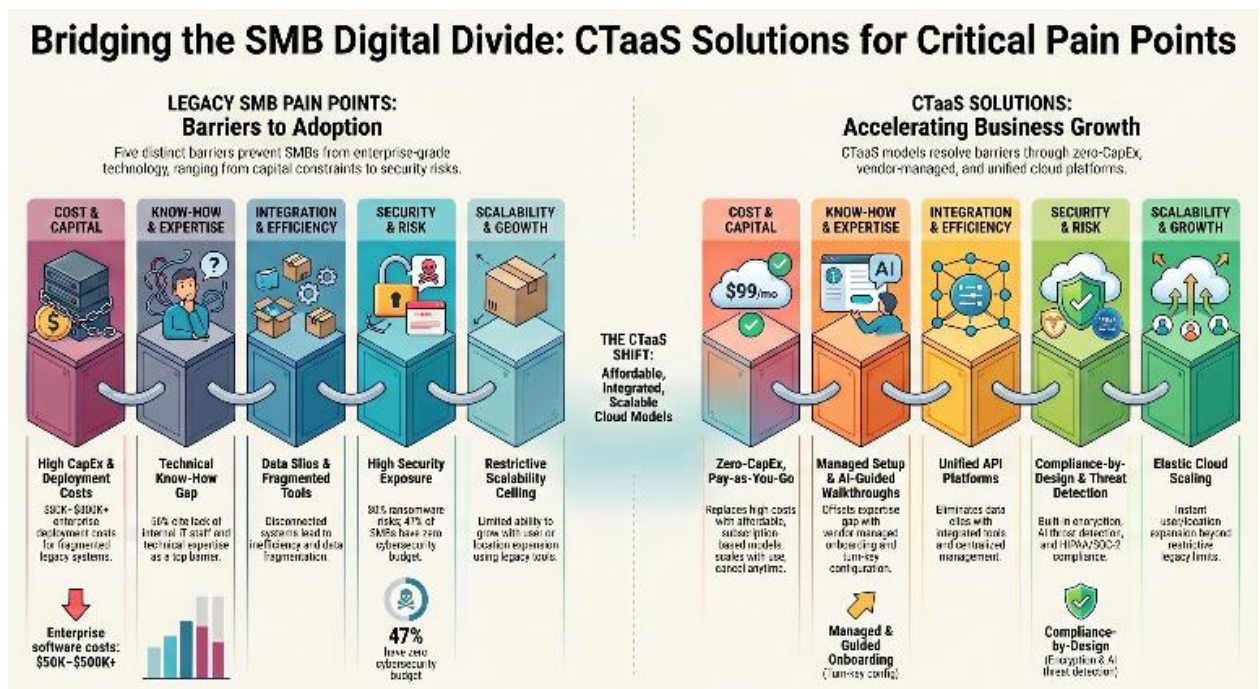


Fig. 3. Bridging the SMB digital divide: mapping legacy small-business pain points to specific CTaaS solutions.



The capital barrier is addressed through pay-as-you-go subscription pricing with no capital expenditure, directly responding to the 45% of SMBs citing budget as a primary constraint [9]. The technical know-how gap is addressed through vendor-managed, turn-key onboarding rather than requiring the business to build internal IT capability. Integration fragmentation is addressed structurally by the unified six-layer architecture itself. Cybersecurity exposure where 47% of small firms report zero budget and 88% of breaches involve ransomware [11], [12] is addressed through compliance-by-design security built into Layer 3. The scalability ceiling is addressed through elastic cloud infrastructure that allows a business to add users, locations, or modules on demand without re-platforming. And the technology upgrade trap is addressed by the subscription model itself: when platform currency is the provider’s responsibility, the trap disappears entirely.

VIII. ADOPTION ROADMAP TOWARD COMPETITIVE PARITY

Translating the CTaaS framework into practice requires a **phased adoption pathway**, since small businesses cannot reasonably absorb a full six-layer transformation in a single step particularly given the workforce constraints discussed in Section IV-B. Fig. 4 presents a **five-phase roadmap** moving a small business from its current pre-digital state to full competitive parity with enterprise peers.

CTaaS Competitive Parity Roadmap for Small Businesses: From Technology Laggard to Enterprise Competitor

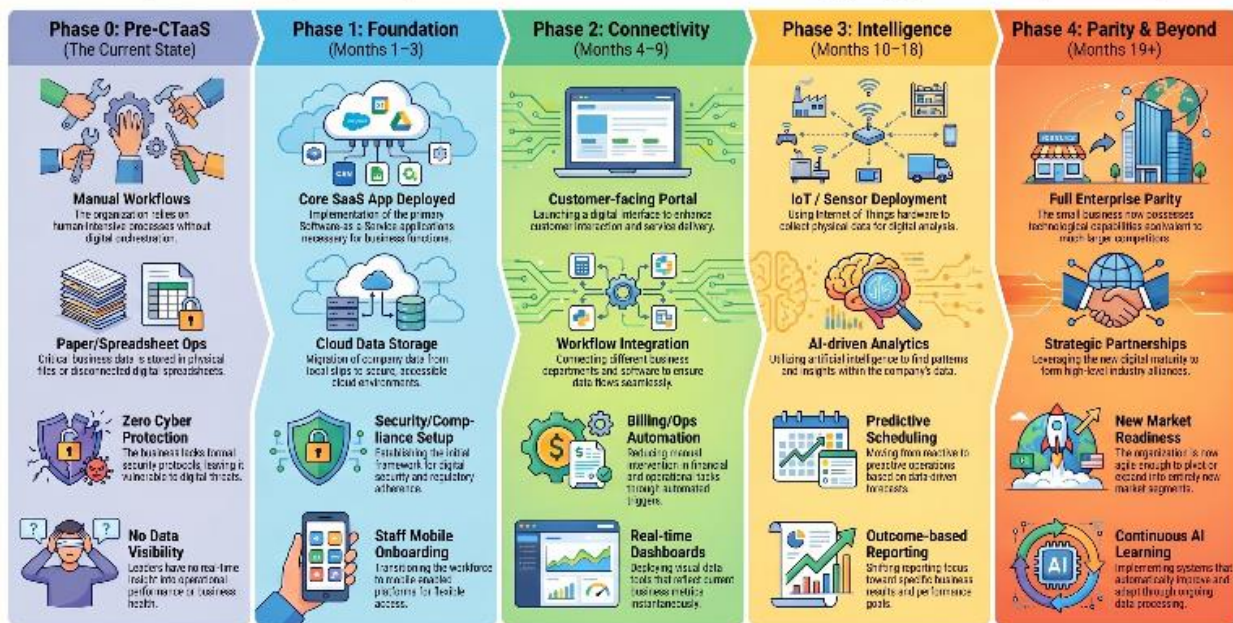


Fig. 4. The CTaaS competitive-parity roadmap for small businesses: from technology laggard (Phase 0) to enterprise competitor (Phase 4).

Phase 0 represents the current state for a substantial share of small businesses: manual, paper- or spreadsheet-based workflows, no cybersecurity protection, and no centralized data visibility. This aligns with findings that 40% of small businesses still routinely accept cash payments and a comparable share rely on manual transaction recording [3]. **Phase 1 (Foundation, months 1–3)** establishes the CTaaS core: a single cloud-hosted application appropriate to the business’s sector (Table I), basic security and compliance configuration, and staff onboarding to mobile-first tools. **Phase 2 (Connectivity, months 4–9)** extends the platform outward, adding customer-facing portals, cross-workflow integration, and automated billing—the stage at which most of the integration-fragmentation barrier is eliminated. **Phase 3 (Intelligence, months 10–18)** introduces IoT sensors and AI-driven analytics, moving the business from reactive to predictive operations. **Phase 4 (Parity and Beyond, month 19 onward)** represents full competitive parity: the small business now operates with the same data visibility, automation, and security posture as a much larger competitor, while retaining the agility and lower organizational overhead that SME literature identifies as an inherent SME advantage [16]. Critically, the business does not re-platform at any phase transition; it simply activates the next module within the same subscription. Table III provides an indicative cost-capability comparison at each stage.



TABLE III
Indicative Cost-Capability Comparison Across CTaaS Adoption Phases

Phase	Indicative Monthly Cost	Capabilities Activated	Competitive Position
Phase 0 — Pre-CTaaS	\$0 (hidden inefficiency cost)	Manual workflows; no data visibility	Structural laggard
Phase 1 — Foundation	\$100–\$250/mo	Core cloud app; baseline security; mobile tools	Compliant baseline
Phase 2 — Connectivity	\$250–\$500/mo	Customer portals; workflow integration; billing automation	Operationally integrated
Phase 3 — Intelligence	\$500–\$900/mo	IoT sensors; AI analytics; predictive operations	Data-driven competitor
Phase 4 — Parity & Beyond	\$900+/mo (scales with size)	Full stack; enterprise-grade posture; strategic partnerships	Enterprise parity

IX. DISCUSSION AND FUTURE DIRECTIONS

The economic stakes of closing the technology gap for small businesses is substantial. With small businesses responsible for 88.9% of net new job creation in the most recent measurement period [2], any structural improvement in their operational efficiency, resilience, or competitiveness has economy-wide effects disproportionate to the size of any individual firm. The CTaaS framework’s central contribution is reframing technology adoption from a procurement decision—in which a small business must independently evaluate, purchase, integrate, and maintain disparate tools into a subscription decision, in which an entire operating capability is delivered, supported, and continuously updated by a managed provider.

The resource backbone concept is the thread that unifies this reframing. Large enterprises have always had IT departments, vendor relationships, and capital budgets that together form an internal technology backbone the infrastructure that keeps their digital operations current, secure, and integrated. Small businesses have never had an equivalent. CTaaS is the first commercially scalable model that delivers this backbone as an external service at small-business price points, without requiring the business to grow into it. This is not merely a cost story. It is a structural parity story: CTaaS does not just make technology cheaper for small businesses.it makes the entire technology management problem someone else’s responsibility.

Several caveats and open questions warrant further research. First, CTaaS depends on a provider ecosystem willing to design genuinely unified, sector-modular offerings rather than re-bundling existing point solutions under a single invoice—the latter would replicate the integration-fragmentation problem under a different commercial wrapper. Second, the OECD’s observation that AI adoption gaps are widening between employer and non-employer firms, even as overall adoption increases [6], suggests that CTaaS pricing models must remain accessible to the 81.9% of small businesses that operate without payroll infrastructure [7], not only to the smaller population of employer firms. Third, as AI capabilities are embedded more deeply into CTaaS Layer 3 and Layer 5, governance becomes critical: with only 51% of SMBs currently having AI-specific security policies [13], CTaaS providers bear a heightened responsibility to embed responsible-AI safeguards by default rather than as an opt-in configuration.

Future research should empirically test the CTaaS framework through pilot deployments across the sector categories identified in Table I, measuring not only adoption rates but also downstream effects on revenue growth, employee retention, and resilience to cybersecurity incidents, relative to matched control groups using traditional point-solution technology stacks. A longitudinal study of the Phase 0–Phase 4 roadmap would also clarify realistic timelines and identify which phase transitions pose the greatest attrition risk for small-business adopters.



X. CONCLUSION

Small businesses represent 99.9% of American enterprises, nearly half of private-sector employment, and over 40% of GDP yet they remain structurally disadvantaged in acquiring, deploying, and sustaining the digital technologies that increasingly determine competitiveness. The gap is measurable and persistent: a 52-point gap in integrated platform adoption, roughly a fourfold gap in AI maturity, and a significant cybersecurity protection gap relative to larger enterprises [4], [5], [10]. But the gap is not primarily one of ambition or awareness. It is a gap in resources the capital to acquire, the expertise to deploy, and the ongoing capacity to maintain and upgrade technology as it evolves.

Connected Technology as a Service (CTaaS) offers a structural response to this resource gap not as a single product, but as an architectural and commercial model that unifies connectivity, cloud infrastructure, AI analytics, cybersecurity, and core business applications into a single, vendor-managed, subscription-based service. By serving as the external resource backbone that small businesses cannot afford to build themselves, CTaaS addresses all five structural barriers simultaneously: eliminating the capital threshold through subscription pricing, resolving the expertise gap through managed complexity, eliminating integration fragmentation through a unified six-layer architecture, building in cybersecurity compliance by design, and ending the technology upgrade trap by making platform currency the provider's responsibility rather than the business owner's.

For the 36.2 million small businesses that constitute the backbone of the U.S. economy, technology should not be a competitive disadvantage determined by firm size. CTaaS offers a pathway for the connected technology already transforming large enterprises to become for the first time the technology that genuinely works for small businesses: at small-business cost, with small-business staffing, on small-business terms, and continuously current without disrupting small businesses.

XI. ACKNOWLEDGMENT

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