InvoFi - Decentralized Web3 Platform for Invoice Financing and Working Capital Management

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Abstract—An invoice-financing platform must answer two questions about each payment. Did the funds move, and who was entitled to them under the accepted invoice terms? InvoFi uses private invoice review, an invoice-specific escrow on Solana, and a separate accounting journal to connect those answers. This engineering case study traces a receivable from buyer confirmation through advance funding, collection and beneficiary claims. It examines how one or several investors can finance the same approved advance and how partial collections can be divided without losing a minor currency unit. The project's Stage I validation record reports two headless cycles on Solana's public development network, one for each funding mode. Together they comprised 24 finalised escrow transactions, beneficiary claims and balanced journals at closure. A worked instalment example shows how the accounting treats principal, investor return, platform fee and the business remainder. The development cycles used synthetic participants and test tokens. Independent reproduction, user-controlled signing through the complete hosted interface, and evidence on business financing outcomes remain open.

Keywords—Invoice financing, working capital, Solana, escrow, repayment allocation, reconciliation

I. INTRODUCTION

A supplier that has delivered an order may still have to pay staff or buy materials weeks before the customer settles the invoice. Receivables financing brings part of that expected payment forward. For a platform that coordinates the advance, a single status such as "paid" is ambiguous. An investor may have deposited funds, the supplier may have received an advance, or the buyer may have settled the debt. These events involve different parties and have different effects on the outstanding balance. A system that cannot distinguish them can show an investor a claim that the buyer has yet to fund.

India's Trade Receivables Discounting System (TReDS) provides a familiar example of why the sequence matters. Its workflow includes counterparty acceptance of a factoring unit, bids by financiers, payment to the supplier and eventual payment by the buyer [1]. InvoFi studies a different operating arrangement in which one or several eligible investors finance a single advance. We use the institutional example to identify the commercial decisions a software model must represent. Any live operating route for InvoFi would require its own approvals and arrangements with participants.

The unit of analysis in this case study is one invoice from submission through settlement. We ask how to link a private review decision to a specific advance, how to keep contributions and collections in balance across multiple investors, and what the available development evidence establishes. We draw on the team's Stage I report for the implementation, test environment and recorded outcomes [2]. A worked example makes the business effect of each accounting entry visible. The practical result is a set of checks that a second evaluator can apply to an invoice even when it receives several payments or a participant retries a request.

II. LITERATURE REVIEW

A. Evidence for a financing decision

Johnson et al. use a supply-chain example to examine a disclosure problem. A supplier may need to establish its connection to a creditworthy trading partner while the firms involved have commercial reasons to protect the relationship [3]. Their work considers retrieving information across private blockchains. InvoFi addresses a narrower question at the point where an invoice is reviewed. The operator needs evidence of the sale and the buyer's response. An investor needs the accepted terms and the exposures relevant to a decision. Giving both parties unrestricted access to the invoice file would disclose information unrelated to the investor's eventual claim.

B. Financing terms and the cost of time

Liu et al. model a three-tier supply chain and show that the relative value of blockchain-based receivables financing depends on assumptions about credit and the time value of capital [4]. This matters when specifying a working-capital platform. An advance of 85 percent has little economic meaning in isolation. The business also needs the maturity, the fee, the return payable to investors and the treatment of a late collection. InvoFi records these terms for each accepted invoice. The case study therefore evaluates whether the agreed allocation can be executed. Estimating a reduction in financing cost would also require observed payment dates, comparable offers and the costs borne by the participants.

C. Trust in a shared settlement record

Gross et al. examined threats to a generic blockchain factoring architecture and identified significant exposure at participant and administrator nodes [5]. Their analysis

motivates examining who can approve a release or change a beneficiary, even where the ledger provides a durable record of transfers. Solana executes the instructions in an individual transaction atomically [6]. That property can bind a token movement to an escrow update. A private database operated by the application still has to learn the result and update its own books. InvoFi's design addresses the interval between these steps, during which a transfer may have succeeded while the application is still waiting for confirmation.

III. METHODOLOGY

A. Case design and evidence

We traced five responsibilities through the Stage I architecture: submission by a business, investment, buyer confirmation or dispute, operator review and platform administration [2]. For each change in an invoice's financial state, we identified the actor, the evidence needed at the time of the decision, and the accounting effect. We then followed a single-investor position and a shared advance through the same repayment rules. This approach makes it possible to identify which controls depend on a person reviewing commercial documents and which can be checked from amounts, permissions or finalised transfers.

We used three kinds of evidence. The implementation description supplies the components and rules. The validation summary in section 8.3 of the Stage I report gives the scope and aggregate outcomes of the development runs. Arithmetic examples check the implications of the rules for instalments and rounding. We report the development results at the level available in that summary. It does not give transaction counts per run, elapsed times or an independent reproduction. The example amounts below are expressed in US dollars for readability and are independent of the test-token balances used in the development runs.

B. Application and settlement responsibilities

The hosted design uses a Next.js interface and a Rust service built on Axum. The service checks identity and current permissions, records accepted terms, and maintains the financial journal in PostgreSQL. Private object storage holds invoices and their supporting documents. A separate Anchor program on Solana controls an escrow account for each invoice. This arrangement gives each invoice an identifiable funding balance. A private journal can associate a payment with its commercial purpose, while the escrow records token movement between authorised accounts. Reconciliation is the comparison of these two records for the same invoice and asset [2].

A person may act for a business that seeks an advance and also have a separately approved investor role. The interface offers different views of those activities. At the service, each request still needs a current personal identity, an authorised business or investor profile and permission for the invoice under consideration. A buyer who follows an invoice-specific invitation has a narrower task: confirming, disputing or paying that invoice. Account ownership, authority to act for a company and control of a signing wallet establish different facts. No individual proof answers all three questions.

This division matters when a user changes a payment wallet or an operator leaves a company. A valid login can survive a change in the user's duties. The rule that matters to the financial operation is the authority in force when it is accepted. The service therefore checks the active profile and applicable limits at the point of commitment. In the same way, an investor's entitlement belongs to the position recorded for the invoice. A payment instruction must use the beneficiary and asset allowed for that position, even if another wallet is connected to the browser.

C. Invoice review and advance release

The supplier submits the invoice identifier, face value, debtor, currency, dates and supporting evidence. A reviewer can compare the invoice with the purchase order, delivery evidence and the buyer's response. The record of review identifies the version examined and the decision made. Once the supplier accepts an advance, the target, agreed return, fee, deadlines and rules for payment are tied to that version. A material revision reopens the relevant approval and consent decisions. This prevents a later change of amount or beneficiary from inheriting approval for an earlier invoice.

The funding target equals the approved advance. For an invoice with a face value of $10,000 and an advance of $8,500, both funding modes have $8,500 to raise. In the first mode one eligible investor supplies that amount. In the second, several investors acquire positions against the same target. Each accepted contribution must fit within the remaining amount and the applicable participant limits. Two investors can both see an available balance before either commits. The authoritative check must include the contribution already committed by the first investor when it evaluates the second.

Reaching the target permits preparation of a release. A separately authorised checker must approve it, and verified movement of the advance is required before the supplier's record shows receipt. If the funding window closes early, the treatment of unused deposits follows the cancellation and refund terms. Each refund belongs to a specific contributing position. The case study treats a refund of unused funding, the release of an advance, and a later buyer repayment as distinct events. Combining them would obscure which party supplied the money and which obligations are still outstanding.

D. Receipt verification and posting

The application checks a candidate settlement against the expected network, escrow program, token mint, recipient, authority and amount. The transaction's finality and actual effects determine whether it can support a receipt. For the development route, token values have six decimal places and the application accounts in cents. A cent corresponds to 10,000 token base units. A value between cent increments requires explicit handling before it can become an application balance. Rejecting an incompatible amount at conversion prevents the chain record and the journal from disagreeing at the first entry.

A receipt must affect the journal once. If a request is retried with the same identifier and the same command, the service should return the previously recorded effect. A different amount or destination submitted under that

identifier is a conflict. There is a second check on the underlying settlement evidence: sending a new application request for a previously credited transfer must not create a fresh collection. When a response is lost, the recovery operation looks for finalised execution and reconciles the balances before posting. A timeout leaves the result unresolved until that check is possible.

E. Allocation of buyer collections

In the ordinary repayment path, eligible collections first repay investor principal, then the agreed investor return, then the agreed platform fee. Any remaining amount belongs to the business [2]. At each priority the amount assigned is the smaller of the available balance and the unpaid amount due at that priority. The business receives the excess after all preceding amounts have been satisfied. This order makes the exposure of each party explicit when the buyer pays less than expected. The amount described as investor return in the terms becomes payable only to the extent supported by collections under those terms.

For an instalment, the calculation uses total eligible collections to date. The journal posts the increase in each party's entitlement since the preceding receipt. This prevents a fixed fee from being charged again whenever a buyer makes a payment. Within an investor category, shares are calculated from the remaining entitlements in integer minor units. The service assigns whole units first, then distributes spare units in descending order of fractional remainder, using an immutable tie-break. A completed allocation therefore has a checkable total and a determinate recipient for the final cent.

IV. RESULTS

A. Recorded development cycles

The Stage I validation summary records two completed financing and repayment cycles on Solana's public development network [2, Sec. 8.3]. One cycle used one investor and the other used multiple investors. Together they accounted for 24 finalised escrow transactions, included beneficiary claims, and ended with balanced closed journals. The test harness exercised the settlement path without a participant using the hosted browser interface. The records concern synthetic identities and test assets. Table I summarises what can be concluded from the reported observations.

TABLE I. SCOPE OF THE STAGE I VALIDATION RECORD [2]

Observation	Scope of evidence
Funding modes	One single-investor cycle and one multi-investor cycle.
Settlement	24 finalised escrow transactions across both cycles.
Closure	Beneficiaries claimed test assets. Both closed journals balanced.
Hosted workflow	Complete browser signing and independent human approval remain to be tested.

A closed journal and an executed claim answer different questions. At closure, the debit and credit entries balance in the accounting record. An executed claim supplies separate evidence that a beneficiary received a transfer through the escrow program. Either observation on its own leaves a gap. A balanced journal could record the wrong business event, while a valid transfer could be associated with the wrong invoice in an application. This is why invoice identity, asset and beneficiary remain necessary in the reconciliation record even after the amounts add up.

B. A worked repayment in three instalments

Consider the Stage I example of a $10,000 invoice, an $8,500 advance, a $300 agreed investor return and a $100 platform fee [2, Table 7.2]. We divide the buyer's collection into three illustrative receipts to expose the change at each priority boundary. The business receives the advance before these receipts. Each column in Table II shows how much of that particular receipt becomes payable at the named priority. The final row is the allocation of all collections, so it excludes the earlier disbursement of the advance.

TABLE II. ILLUSTRATIVE ALLOCATION BY RECEIPT (USD)

Receipt	Principal	Return	Fee	Business
8,400	8,400	0	0	0
250	100	150	0	0
1,350	0	150	100	1,100
10,000	**8,500**	**300**	**100**	**1,100**

The first $8,400 leaves $100 of principal outstanding. From the second receipt, $100 finishes principal and $150 becomes investor return. The final receipt provides the other $150 of return and the $100 fee. The remaining $1,100 belongs to the business. The business has then received $9,600 in total, comprising the $8,500 advance and the $1,100 residual. The $400 difference from face value is the sum of the illustrative return and fee. If the third receipt never arrives, the position at that point has $150 of return outstanding and no fee or business residual supported by the collections.

Suppose the two investor positions are $5,000 and $3,500. With a proportional split of the $300 return according to those amounts, the exact shares fall between cents. Rounding down gives $176.47 and $123.52, leaving one cent. The second investor has the larger remainder and receives $123.53. The two total claims at full repayment are $5,176.47 and $3,623.53. Together with the fee and business residual they sum to $10,000. This hand calculation illustrates the full-payment result. Small instalments can change which position receives an intermediate rounding cent while preserving the total available for distribution.

V. DISCUSSION

A. What a participant can verify

An investor who knows the agreed asset, invoice escrow and beneficiary address can inspect a finalised transfer independently of the platform's screen. The investor still relies on the operator to establish whether the supplier delivered the goods, whether the buyer accepted the invoice and whether an assignment was previously made elsewhere. These are material limits on the word "decentralized" in the project title. Settlement evidence can be distributed even when underwriting, eligibility, dispute handling and document access remain under identifiable institutional control. A working-capital decision depends on both kinds of evidence.

Consider a buyer who disputes the quantity delivered after the advance has been paid. Neither a valid investor deposit nor a balanced advance entry decides that dispute. The operator needs the versioned invoice, the delivery evidence, the buyer's response and the accepted rules for servicing the position. If only a partial payment is verified, the system can allocate that payment under the applicable terms while keeping the outstanding obligation visible. A later recovery or correction needs its own reviewed entry so that a reader can reconstruct the sequence from advance to final disposition.

Document privacy also has an operational cost. A borrower may be willing to share a purchase order with the reviewer while objecting to disclosure of its customer list to investors. The prototype stores files privately and limits reads by current authority. Public settlement amounts and their timing may still reveal trading relationships when combined with information from outside the platform. Uploading a recognisable document hash adds another means of linking a known invoice to its settlement history. The information needed to verify a token claim is consequently a poor guide to which commercial documents should be made public.

The same distinction affects what the supplier should see in its working-capital view. In the instalment example, after the first two receipts the buyer has paid $8,650 and investors have recovered their principal. The supplier has received the original advance, but none of the buyer's collections have become payable to it. A screen that reports only the percentage of the invoice collected would suggest a very different cash position. Showing the advance already received, the residual currently claimable and the sum still owed by the buyer allows the supplier to reconcile its own bank or wallet records with the invoice history.

B. Follow-up tests and comparison design

A reproducibility exercise should begin with one invoice, its accepted terms and the initial asset balances of every participant. An independent evaluator would record the software revision and network, run both funding modes, and match each finalised receipt with the corresponding journal entry and change in escrow balance. The closing check would compare the individual claims as well as the total. This design can detect an error that swaps two investors' amounts while leaving the journal balanced. It would also make clear which results depend on the token configuration used for the development runs.

Two boundary cases deserve particular attention. First, two contributions that individually fit the last available capacity may exceed it together. The evaluation should record the order of acceptance, the final accepted balance and the treatment of the unsuccessful contribution. Second, a receipt may settle while the service temporarily loses its connection to the network. Restoring the service and replaying the request should produce one credited receipt and a matching balance. The Stage I report lists concurrency, recovery and hosted signing among its evaluation tasks. The two completed cycles do not quantify reliability under these conditions [2].

There is also a practical limit on participation. The development escrow described in Stage I allows up to 32 investor beneficiaries per invoice [2, Sec. 7.4]. The summary gives no participant count for the multi-investor cycle beyond establishing that it involved more than one. A capacity study would have to vary the number of positions, including the configured limit, and retain per-position claim evidence after each run. This would test whether the accounting stays reconcilable as participation grows and identify the cost of settling many small claims.

A useful comparison with a conventional application would preserve the same invoice review, release approvals, repayment terms and role assignments. Only the settlement route and associated verification work would change. Time from review to a usable advance, participant signing effort, reconciliation time and the cost of resolving a missing receipt could then be measured on matched cases. Network fees alone omit the work of reviewing evidence, collecting payments and resolving disputes. The present case has no merchant sample or control group from which to estimate savings, changes in default risk or improved access to working capital.

VI. CONCLUSION

InvoFi gives a supplier, its investors and an operator a common way to identify what has happened to one approved advance. Versioned terms determine who may be paid, an invoice-specific escrow identifies where funds move, and the journal records what each movement means for the outstanding positions. The worked example shows why those distinctions matter when a buyer pays in instalments. A single $250 receipt can finish principal repayment and begin paying investor return, with the platform fee and supplier residual still outstanding.

The reported result is limited to two synthetic headless cycles, 24 finalised devnet escrow transactions and balanced journals at closure. Completing a hosted cycle with participant-controlled wallets and genuinely independent release approval would extend the evidence to the human workflow. Independent reproduction, recovery tests and measured workloads would establish how consistently that path operates. Economic conclusions require a later study of real financing arrangements with observed costs, payment dates and outcomes.

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