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Design and Feasibility Evaluation of a Web-Based Container Damage Reporting Information System for Container Terminal Operations

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ABSTRACT

Purpose: This research designs and evaluates a web-based information system for Container Damage Report (CDR) management in container terminal operations. The research focuses on browser-based access, centralized cloud records, and operational usability.
Methods: The 4D development model is define, design, develop, and disseminate was applied. Operational requirements were identified through field observation, interviews, workflow review, and document analysis. A no-code cloud prototype integrated Tally for structured input and photo upload, Google Sheets for centralized records, and Google Sites as a web portal. Pilot validation assessed functional suitability, usability, information clarity, workflow compatibility, and perceived usefulness.
Results: The prototype supports required-field reporting, timestamped records, linked photo evidence, browser-based retrieval, and status monitoring. Three role-representative respondents produced scores of 76%, 94%, and 84% (mean 84.67%; sample standard deviation 9.02 percentage points). These results provide formative evidence for pilot use but are not statistically generalizable.
Novelty: The research contributes a lightweight, human-centered CDR reporting model that uses no-code cloud tools as a transitional architecture before integration with enterprise terminal operating systems.

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1. INTRODUCTION

Container terminals are time-sensitive logistics nodes that coordinate vessel operations, yard activities, container movements, and operational documentation. Reliable information is therefore essential for service continuity, accountability, and rapid decision-making [1]. Recent Port 4.0 research further emphasizes that digitalization should connect operational processes and information flows rather than merely convert paper forms into electronic documents [2].

One activity that requires reliable documentation is the Container Damage Report (CDR), which records the physical condition of containers identified during inspection, loading, unloading, or yard handling. Damage information supports repair decisions, customer clarification, insurance evidence, and responsibility tracing. Recent studies have examined critical damage events during crane handling [3] and automated image-based container damage detection [4], confirming the operational importance of accurate and traceable damage records.

In the observed terminal operation (ops), the previous CDR workflow still relied on paper forms, verbal confirmation, and photo files stored separately from the report record. This fragmentation created repeated data entry, a risk of transcription errors, uncertain links between photos and container records, and slow retrieval of historical reports by container number, date, damage category, or follow-up status.

The previous and proposed workflows differ in several practical respects. The manual process uses paper and verbal communication, stores documents and photos in separate locations, and provides delayed access to historical records. The proposed workflow uses required online fields and photo upload, stores data in a centralized cloud record, enables browser-based access, and supports filtering without repeated transcription. Low-code and no-code research indicates that such tools can accelerate the development of task-specific systems, although usability and governance must remain explicit design concerns [5]. Port digitalization studies similarly warn that interoperability, security, organizational readiness, and stakeholder coordination can limit the value of digital initiatives [6].

Representative studies illustrate both the potential and the remaining gap. Ding et al. developed a digital-twin decision-support system for real-time monitoring and resource allocation at an automated container terminal [7]. Pamungkas et al. developed a web-based container monitoring system for a port environment [8]. The former addresses a high-capability terminal architecture, whereas the latter focuses on general container monitoring. Neither specifically explains a lightweight CDR workflow that links field reporting, photographic evidence, cloud storage, browser retrieval, and formative user validation in a single no-code architecture.

This research addresses that gap by designing and evaluating a web-based CDR information system for container terminal operations. Its contribution lies in translating field reporting needs into a usable applied-computing prototype, clarifying the relationship between the development process and system architecture, and reporting pilot validation with both central-tendency and variability measures. The scope covers damage-report input, evidence documentation, storage, retrieval, and report monitoring; it does not cover financial claims, automatic damage recognition, or full integration with a terminal operating system.

2. RELATED WORK

Research on smart ports generally treats digitalization as a combination of technology, process integration, and organizational capability. Belmoukari et al. synthesized the smart-port literature and identified multiple business domains that extend beyond equipment automation [9]. Heikkilä et al. likewise showed that future container-port innovation depends on coordinated data sharing, digital services, and ecosystem collaboration [10]. A complementary port-digitalization assessment also shows the value of evaluating digital capability systematically [11]. These studies provide a broad theoretical foundation, but they do not specify how a small operational unit can digitize a narrowly defined reporting task with limited infrastructure.

A second stream examines technological trajectories and maturity. Inkinen et al. described alternative seaport digitalization scenarios and highlighted the influence of policy, business conditions, and technology choices [12]. Boullauazan et al. proposed a maturity model for smart ports, demonstrating that digital transformation develops progressively rather than through a single system replacement [13], [14]. This supports the use of a transitional architecture for organizations that need immediate process improvement before enterprise-level integration is available.

Container-damage research has primarily concentrated on detection and handling risk. Wang et al. applied transfer learning to classify multiple container-damage types from images [4], while Jakovlev et al. statistically evaluated impact detection during quay-crane handling [3]. These approaches strengthen automated detection, but they do not address the human reporting workflow required to register findings, attach evidence, retrieve records, and coordinate follow-up actions.

Web-based and low-code studies offer a practical implementation pathway. Pinho et al. found that usability is a central concern in low-code development because many users are not professional programmers [5]. Recent web-based system development also demonstrates the value of browser access and task-oriented interfaces in organizational settings [13], while container-depot systems show the relevance of centralized web records for operational monitoring [15]. The present research extends this line of work by combining a 4D development process, a no-code cloud architecture, and a role-based pilot evaluation for the specific CDR task.

3. METHOD

This research used the 4D development model consisting of define, design, develop, and disseminate stages [14], [15]. The model was selected because it provides a systematic sequence for translating an operational problem into a functional prototype while still permitting feedback-based refinement. In this research, each stage had a distinct analytical purpose rather than functioning only as a procedural checklist.

The define stage identified the current CDR workflow, user roles, reporting constraints, and required data elements. Field observation, informal interviews, workflow review, and document analysis were used to determine where information was lost, duplicated, delayed, or separated from photographic evidence. The main actors were field inspectors, administrative operators, supervisors, and users who retrieve historical CDR records.

The design stage converted the identified problems into functional and non-functional requirements. Functional requirements included required container-identification fields, damage description, photo upload, automatic timestamping, centralized storage, report search, and status monitoring. Non-functional requirements included browser accessibility, low implementation cost, ease of learning, compatibility with existing routines, and a structure that could later be migrated to a stronger enterprise architecture.

The develop stage implemented the prototype through a no-code cloud architecture. Tally provided structured fields and file upload, Google Sheets stored submitted records in a filterable tabular database, and Google Sites served as the web portal for reporting links, monitoring pages, and documentation. Integration testing checked whether a report could move from field input to validation, cloud storage, browser retrieval, and administrative review without manual re-entry.

The disseminate stage introduced the prototype to a limited group of prospective users. Respondents completed a reporting scenario that included submitting container data, attaching photo evidence, checking the stored record, and locating information through the portal. Feedback was collected immediately after task completion to support formative refinement rather than to claim population-level effectiveness.

Pilot validation involved three purposively selected respondents representing field and administrative roles. The evaluation indicators were functional suitability, usability, information clarity, workflow compatibility, and perceived usefulness. Functional suitability assessed whether required reporting and retrieval functions operated as intended; usability assessed ease of learning and task completion; information clarity assessed labels, instructions, and displayed records; workflow compatibility assessed alignment with inspection and verification routines; and perceived usefulness assessed expected support for traceability and follow-up. The first two indicators were aligned with the ISO/IEC 25010:2023 product-quality model, while the remaining indicators reflected context-specific requirements established during the define stage. The indicators and operational definitions are summarized in Table 1.

Each indicator was rated using the research's Likert-based instrument. The respondent percentage was calculated as: score (%) = (obtained score / maximum possible score) × 100. Respondent-level percentages were summarized using the arithmetic mean, sample standard deviation, and range. Because n = 3, the analysis is descriptive and formative; no inferential test or claim of generalizability was made.

Table 1 provides the evaluation criteria used during pilot validation. Presenting the indicators explicitly improves transparency by showing which prototype qualities were assessed and why they were relevant to the CDR workflow.

Table 1. Prototype validation indicators and operational definitions

Indicator	Operational definition	Basis
Functional suitability	Required CDR input, photo, timestamp, storage, search, and monitoring functions operate as intended.	ISO/IEC 25010:2023
Usability	Users can learn and complete the reporting and retrieval tasks through a browser with limited assistance.	ISO/IEC 25010:2023
Information clarity	Labels, instructions, status information, and stored records are understandable to operational users.	CDR information needs z
Workflow compatibility	The prototype aligns with field inspection, administrative verification, and follow-up activities.	Define-stage requirements
Perceived usefulness	Users expect the prototype to improve traceability, documentation, retrieval, and response time.	Formative user assessment

Figure 1 summarizes how the four stages contribute to the research objective. Define establishes evidence-based requirements and prevents the prototype from reproducing an unsuitable manual routine. Design converts those requirements into a process flow, data structure, and interface plan. Develop implements and tests the integrated prototype, while disseminate exposes it to representative users so that operational weaknesses can be identified before wider deployment.

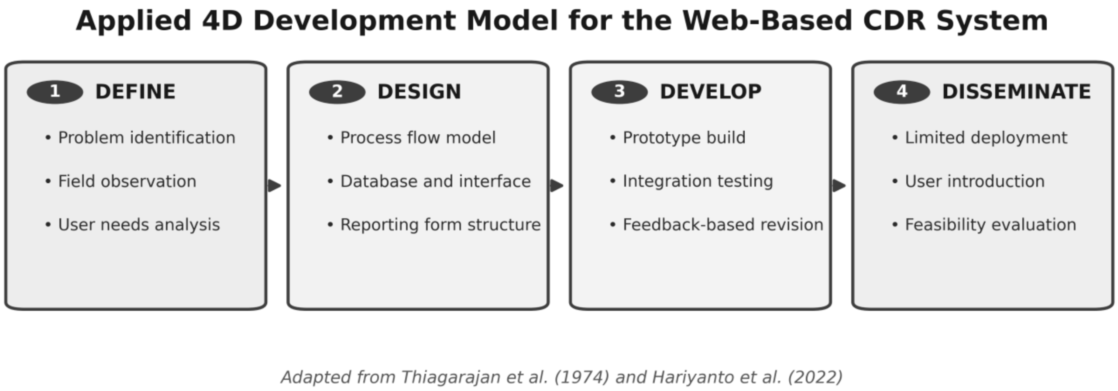

Figure 1. Applied 4D development model for the web-based CDR system

Figure 2 is the technical elaboration of the design and develop stages shown in Figure 1, not a separate methodology. Figure 1 explains the research-development sequence, whereas Figure 2 shows how the resulting requirements are implemented as a data flow from the field inspector to the online form, processing layer, cloud database, web portal, administrative users, supervisors, and archived reports. This relationship connects the methodological rationale with the operational architecture.

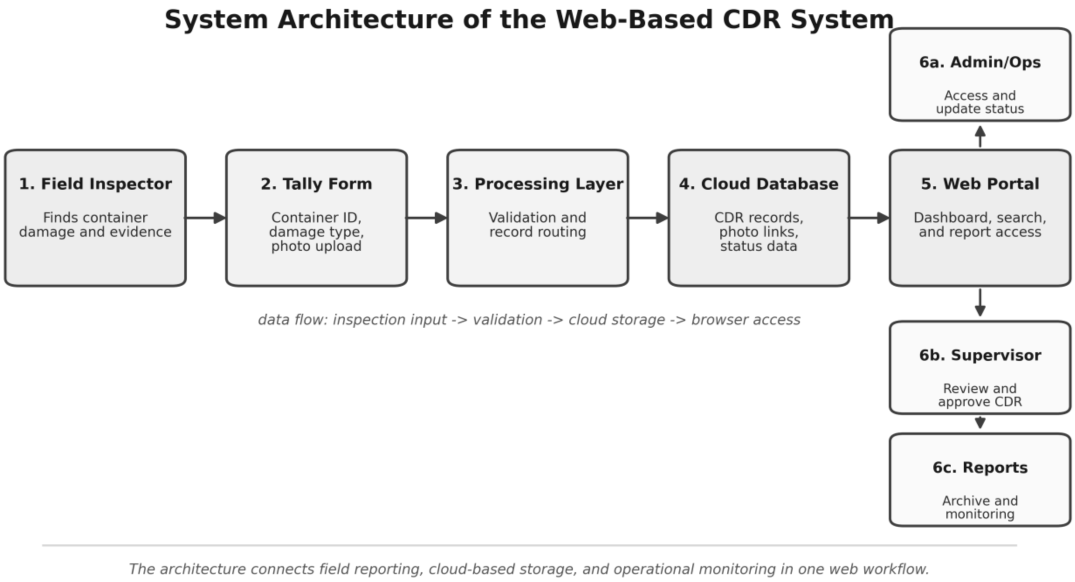

Figure 2. System architecture integrating field input, cloud database, and web portal

4. RESULTS AND DISCUSSION

The resulting prototype digitizes the main CDR workflow from field inspection to managerial review. Users enter container identification, damage category, condition details, and supporting photographs through the online form. The submission is timestamped, stored in the centralized cloud record, and made available through the portal for verification, retrieval, and status monitoring.

The architecture shown in Figure 2 connects field input, validation, cloud storage, and browser-based access in one workflow. Its main value is not technological complexity but continuity of information: the same record created during inspection becomes the record reviewed by administrative and supervisory users. This reduces the separation between textual reports and photographic evidence.

Functionally, the system improves the workflow in four ways. First, required fields standardize data entry. Second, photo evidence is linked directly to the submitted record. Third, centralized storage supports filtering by container number, date, damage category, and status. Fourth, browser access allows relevant users to review the record without waiting for paper transfer or separate photo delivery.

The pilot evaluation results are presented in Table 2 and visualized in Figure 3. The three respondents assigned scores of 76%, 94%, and 84%. The mean was 84.67%, the sample standard deviation was 9.02 percentage points, and the range was 18 percentage points. Reporting the standard deviation is important because the difference between field and administrative assessments indicates that perceived suitability was not fully uniform across roles.

User 1, representing the field role, produced the lowest score (76%), suggesting that field conditions and task simplicity require further refinement. User 2, representing administrative operations, produced the highest score (94%), indicating strong perceived support for record organization and retrieval. User 3 scored 84%, indicating a generally positive assessment for planning and monitoring. These respondent-level interpretations are descriptive and should not be treated as evidence of statistical effectiveness.

The pilot mean indicates that the prototype is promising for early operational trial, but the small purposive sample substantially limits reliability and external validity. With only three respondents, one individual score has a large influence on the mean, and the observed variability cannot establish consistent acceptance across the wider user population. The result is therefore used as formative evidence to identify refinement priorities and justify a larger validation research.

Table 2. Pilot user-validation scores and descriptive statistics

Respondent	Role	Score (%)	Descriptive note
User 1	Field officer (Solo/Whiskey)	76	Individual pilot score
User 2	Administrative operations	94	Individual pilot score
User 3	Administrative planner	84	Individual pilot score
Mean	-	84.67	Arithmetic mean
Sample SD	-	9.02	Percentage points

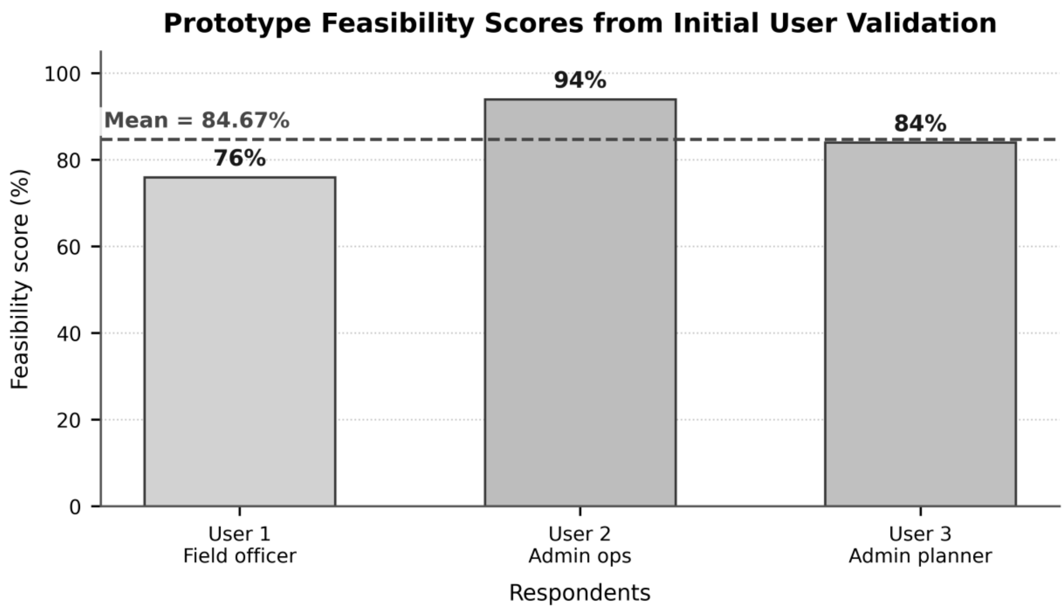

Figure 3. Pilot validation scores (mean 84.67%; sample SD 9.02 percentage points)

Beyond the respondent scores, the prototype was interpreted across technical, operational, economic, and data-management dimensions. The qualified pilot findings and their implications are summarized in Table 3.

Table 3. Qualified summary of pilot feasibility analysis

Dimension	Pilot finding	Qualified implication
Technical	Operated through a browser and cloud services during the pilot.	No special local infrastructure was needed for the limited trial.
Operational	Supported field input and office review within the tested scenario.	Suggests potential for a simpler reporting flow, subject to wider testing.
Economic	Used low-cost no-code platforms.	May reduce initial development overhead, but long-term costs were not evaluated.
Data management	Centralized submitted records and browser-based retrieval.	Improved pilot traceability; backup, security, and scale require further testing.

Table 3 indicates that the prototype was technically accessible and operationally understandable within the limited trial. However, these findings should be interpreted as scenario-based observations rather than verified production performance. Browser access and cloud storage simplified the pilot setup, but they do not by themselves establish reliability, security, or scalability.

The main contribution is therefore a transitional information-system design. Port digitalization research recognizes that transformation often progresses through stages shaped by technological maturity and organizational readiness [12], [16] The prototype offers a structured intermediate step for units that need immediate digital reporting while planning later integration with stronger authentication, audit, backup, and terminal-operating-system services.

Several limitations remain. The prototype was tested by only three purposively selected respondents, so the findings are susceptible to individual judgment and cannot be generalized. The research did not evaluate long-term adoption, high-frequency reporting, unstable network conditions, cybersecurity controls, performance under load, or enterprise integration. Future validation should recruit a larger and more diverse sample, report indicator-level scores and reliability, conduct task-time and error testing, and assess security, availability, backup, and application-programming-interface integration.

Overall, the results position the research as an applied information-system design and formative feasibility evaluation. The port context provides the operational case, while the contribution lies in the explicit connection between the 4D process, the no-code cloud architecture, and transparent pilot evidence. This positioning differentiates the research from automated damage-detection research and from high-capability smart-port platforms.

5. CONCLUSION

This research designed and evaluated a web-based Container Damage Report information system for container terminal operations using a no-code cloud architecture and the 4D development process. The prototype connects structured field input, photographic evidence, timestamped cloud records, browser-based retrieval, and report monitoring in one workflow. Pilot scores from three role-representative respondents averaged 84.67%, with a sample standard deviation of 9.02 percentage points. The result indicates promising formative acceptance, but the small sample prevents generalization or a definitive claim of operational effectiveness. The main contribution is a lightweight transitional architecture that can support initial CDR digitization before enterprise integration. Further research should involve more users, indicator-level reliability analysis, longer implementation periods, security and performance testing, and integration with terminal operating and document-management systems.

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CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Author1: Supervision, conceptualization, writing, reporting, and submission. **Author2** and **Author3**: Review and validation. **Author4** and **Author5**: Methodology and system design. **Author6**: Data collection, software implementation, and project administration.

DECLARATION OF COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

DATA AVAILABILITY

The processed evaluation data supporting the findings of this research are available from the corresponding author upon reasonable request.

REFERENCES

[1] M. G. Burns, “Port Management,” in *International Encyclopedia of Transportation*, vol. 4, Amsterdam, The Netherlands: Elsevier, 2021, pp. 390–395. doi: 10.1016/B978-0-08-102671-7.10483-X.

[2] B. Behdani, “Port 4.0: A conceptual model for smart port digitalization,” *Transportation Research Procedia*, vol. 74, pp. 346–353, 2023, doi: 10.1016/j.trpro.2023.11.154.

[3] S. Jakovlev, “Statistical evaluation of the impacts detection methodology (IDM) to detect critical damage occurrences during quay cranes handling operations,” *Machines*, vol. 11, no. 6, 2023, doi: 10.3390/machines11060638.

[4] Z. Wang, J. Gao, Q. Zeng, and Y. Sun, "Multitype damage detection of container using CNN based on transfer learning," *Math. Probl. Eng.*, vol. 2021, 2021, doi: 10.1155/2021/5395494.

[5] D. Pinho, A. Aguiar, and V. Amaral, "What about the usability in low-code platforms? A systematic literature review," *J. Comput. Lang.*, vol. 74, 2023, doi: 10.1016/j.cola.2022.101185.

[6] F. Almeida, "Challenges in the digital transformation of ports," *Businesses*, vol. 3, no. 4, pp. 548–568, 2023, doi: 10.3390/businesses3040034.

[7] Y. Ding, "Real-time monitoring and optimal resource allocation for automated container terminals: A digital twin application at the Yangshan Port," *J. Adv. Transp.*, vol. 2023, 2023, doi: 10.1155/2023/6909801.

[8] A. A. Pamungkas, S. Sharyanto, and J. Saputro, "Design and development of a web-based container monitoring system in a port environment," *Jurnal Sains dan Teknologi Widyaloka*, vol. 1, no. 2, pp. 223–228, 2022.

[9] B. Belmoukari, J.-F. Audy, and P. Forget, "Smart port: A systematic literature review," *European Transport Research Review*, vol. 15, 2023, doi: 10.1186/s12544-023-00581-6.

[10] M. Heikkilä, J. Saarni, and A. Saurama, "Innovation in smart ports: Future directions of digitalization in container ports," *J. Mar. Sci. Eng.*, vol. 10, no. 12, 2022, doi: 10.3390/jmse10121925.

[11] V. Paulauskas, L. Filina-Dawidowicz, and D. Paulauskas, "Ports digitalization level evaluation," *Sensors*, vol. 21, no. 18, 2021, doi: 10.3390/s21186134.

[12] T. Inkinen, R. Helminen, and J. Saarikoski, "Technological trajectories and scenarios in seaport digitalization," *Research in Transportation Business & Management*, vol. 41, 2021, doi: 10.1016/j.rtbm.2021.100633.

[13] F. Assyifaurrohmah, A. F. Mubin, and A. T. Tabrani, "Development of a web-based teacher attendance system in government agencies: A case study at the Ministry of Religious Affairs," *Intechno Journal: Information Technology Journal*, vol. 7, no. 1, pp. 24–33, 2025, doi: 10.24076/intechnojournal.2025v7i1.2233.

[14] S. Thiagarajan, D. S. Semmel, and M. I. Semmel, *Instructional Development for Training Teachers of Exceptional Children: A Sourcebook*. Bloomington, IN, USA: Indiana University, 1974.

[15] T. M. Pardede, "Web-based container depot information system," *Jurnal Armada Informatika*, vol. 6, no. 2, pp. 1–6, 2022.

[16] Y. Boullauazan, C. Sys, and T. Vanelslander, "Developing and demonstrating a maturity model for smart ports," *Maritime Policy & Management*, vol. 50, no. 4, pp. 447–465, 2023, doi: 10.1080/03088839.2022.2074161.