

A Study on The Role of Human Resource Information System (HRIS) In Inculcating Quality and Standards Required for Strong Customer Relationship Management (CRM) In Selected Private Sector Commercial Banks in India

Shifa Nooris Khan¹, Dr. Sucheta Yambal²

¹*Faculty of Commerce and Management Dr. Babasaheb Ambedkar Marathwada University*

²*Assistant Professor Dr. Babasaheb Ambedkar Marathwada University*

Abstract—Human Resource Information Systems (HRIS) can support Customer Relationship Management (CRM) when employee information is translated into verified service capabilities and operational controls. This paper develops and evaluates an offline prototype for the intended context of selected private sector commercial banks in India. The evaluation combines a supplied questionnaire dataset containing 35 records and 34 items with a controlled service-routing simulation. The prototype validates inputs, reports response-pattern diagnostics, calculates six construct scores, generates candidate improvement actions, and assigns simulated cases using active status, skills, certificate validity, and staff availability. HRIS and CRM scores average 4.576 and 4.686, respectively, with Pearson $r = 0.953$; these statistics describe constructed data and do not establish a banking relationship. Seven records are constant, and only response categories 4 and 5 occur. Eighteen functional checks pass. Twelve routing scenarios, each evaluated over 30 replications of 500 cases, demonstrate a conditional trade-off. With sparse additional skills, frequent arrivals, and a six-minute mismatch penalty, qualified routing increases simulated service-target attainment from 10.85% to 87.33%. With the same staffing and arrivals but no mismatch penalty, attainment falls from 98.28% to 87.33%. The contribution is a reproducible implementation and evaluation framework linking HRIS capabilities to service standards, including evidence of situations in which qualification constraints create delay. Field validation is required before drawing conclusions about employee behaviour, customer satisfaction, or individual banks.

Index Terms—HRIS; CRM; private sector banking; employee capability; service quality; simulation; skills-based routing.

I. INTRODUCTION

1.1 From personnel information to customer service capability

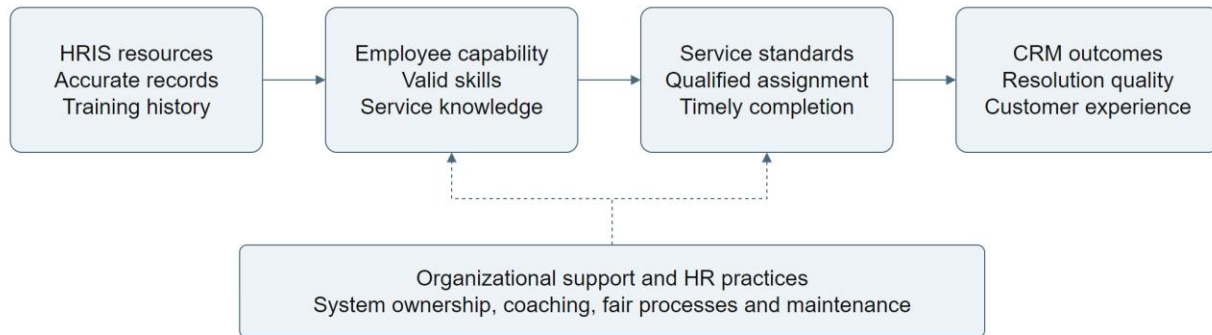
HRIS brings employee records, HR workflows, and decision support into a shared information environment. The broader concept of electronic human resource management concerns the integration of HRM and information technology to create value for employees and management [1]. An implementation relevant to customer service must connect that information to what staff can reliably do: understand a product, follow a service procedure, recognize when assistance is needed, and resolve a request within an appropriate time. A database of training attendance alone does not demonstrate that those capabilities exist.

The distinction between technical installation and organizational benefit is central to information-systems evaluation. System quality, information quality, service quality, use, satisfaction, and net benefits are related but separate evaluation concerns [2]. In banking, this distinction means that an employee may regard an HR application as easy to use while customers still experience repeated transfers or delayed responses. HRIS effectiveness should therefore be examined through both

employee-facing measures and independently observed service events.

Research in banking connects employee knowledge and attitude with CRM [3], and links employee commitment and job satisfaction with service quality [4]. These relationships motivate an operational mechanism: use verified employee capability to

support service assignment, and use recurring service problems to inform training and staffing reviews. Figure 1 presents that mechanism as a proposition for investigation. The directional arrows express the intended process; they are not coefficients or established causal paths.



Conceptual mechanism for field testing. Arrows do not represent causal estimates from the synthetic data.

Figure 1. Conceptual pathway connecting HRIS resources, employee capability, service standards, and CRM outcomes. Organizational support sustains the process. Author-created synthesis informed by [1]–[4].

1.2 Problem statement and scope

Studies of HR and IT resources in banking already examine their association with CRM performance [5]. Indian private-bank research also identifies timely service, trustworthy staff behaviour, and procedural convenience as relevant CRM practices [6]. The implementation problem addressed here is more specific: how can a bank translate HRIS information into an inspectable service rule, and how can that rule be evaluated without confusing employee perceptions with actual customer outcomes?

The intended application domain is selected private sector commercial banks in India. The present evaluation does not contain observations from a selected set of banks. Its questionnaire records are , despite the source filename referring to ICICI. No claim is made about ICICI Bank, HDFC Bank, Axis Bank, or any other institution. The title identifies the broader research programme; this paper reports the implementation and simulation stage of that programme. There is no bank-wise comparison, representative employee sample, customer survey, or measured deployment effect.

1.3 Research questions and contributions

Three questions guide the study. RQ1 asks whether a reproducible pipeline can operationalize the questionnaire and identify defects in its data. RQ2 asks how eligibility derived from HRIS can govern service assignment while retaining an explicit escalation path. RQ3 asks under what assumed workload, skill-coverage, and mismatch-cost conditions qualified routing improves or worsens simulated service-target attainment.

The paper contributes a traceable 34-item data dictionary; a working validation, scoring, and review pipeline; a deterministic routing prototype; and a scenario-based comparison with a workload-only baseline. The contribution is an inspectable artifact and its boundary conditions. It does not claim a new causal theory or the discovery of an empirical HRIS–CRM effect. This positioning follows the distinction between building and evaluating an information-system artifact and testing organizational behaviour [9]. Transparent simulation design is particularly important when assumptions, rather than field observations, determine the experiment [10].

II. RELATED WORK

2.1 Review approach

A focused narrative review was conducted using the project's HRIS and CRM documents and targeted searches of journal publishers and institutional repositories. Search combinations concerned HRIS or electronic HRM, employee capability, banking service quality, and CRM. Studies were retained when their identity and a relevant method or finding could be checked. This is a purposive review, not a systematic review or meta-analysis. No numerical

effect was reconstructed from an abstract that did not provide one.

The evidence spans three complementary areas. HRIS research explains adoption and organizational conditions; employee-service research connects capabilities and attitudes to service experience; CRM research addresses the customer-facing relationship. These areas support the proposed integration, but their surveys cannot establish the runtime performance of the routing rule developed here. Figure 2 shows how the review leads to two distinct evaluation tasks.

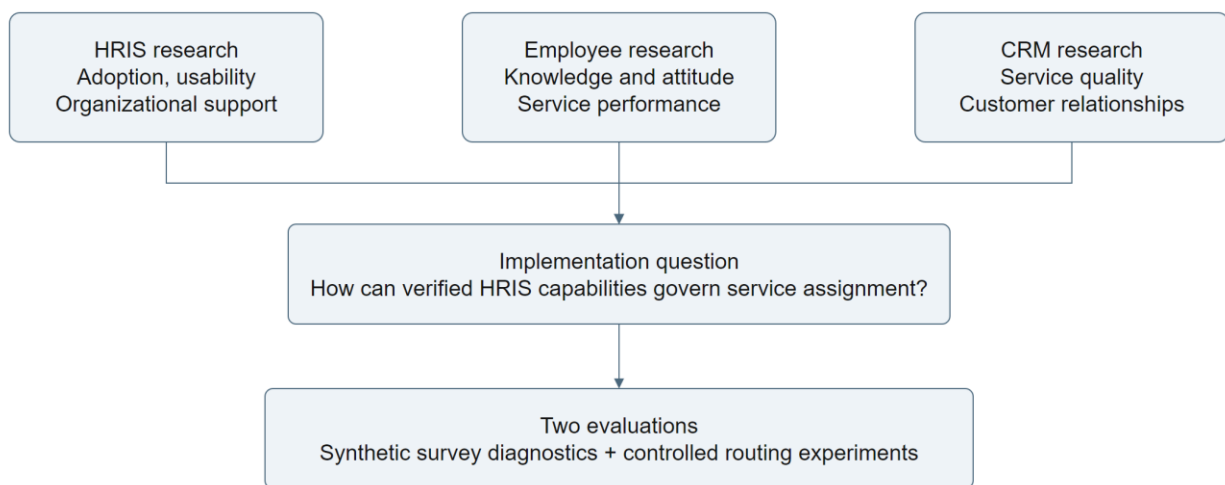


Figure 2. Evidence streams and evaluation tasks. This is an author-created organization of the literature, not a reproduction of a published model. Sources include [3]–[8].

2.2 Comparative evidence

Table 1. Summary of related work and the implementation issues it leaves open

Study	Setting and setup	Reported result	Relevance and boundary
Malhotra and Mukherjee [4]	342 employees ; four call centres in one UK retail bank; employee survey.	Commitment and job satisfaction relate to service quality; affective commitment has greater importance.	Supports employee-side mechanisms; no HRIS routing experiment.

Study	Setting and setup	Reported result	Relevance and boundary
Rootman et al. [3]	South Africa; 290 banking clients; structured questionnaire; 91.03% response rate reported.	Employee knowledgeability and attitude show significant positive relationships with CRM.	Customer perspective strengthens relevance; observational and geographically specific.

Study	Setting and setup	Reported result	Relevance and boundary
Wang and Yang [5]	Five Taiwanese banks; 800 questionnaires distributed in 2012; personnel and customer samples; hierarchical regression	Tests HR capability, IT application, and their interaction in CRM performance	Direct HR–IT–CRM framing; distributed count is not an analyzable sample count; no effect size reproduced here.
Valmohamadi [13]	Bank Sepah in Maku, Iran; structured questionnaire administered through interviews	Communication, customer-needs information, and conflict handling are emphasized for service quality.	Provides service-process targets; single-bank, cross-sectional evidence.
Bondarouk et al. [8]	Review of 69 empirical articles: 37 quantitative, 20 qualitative, 12 mixed methods.	Adoption factors are grouped into technology, organization, and people.	Supports implementation context; heterogeneous studies do not supply a common CRM effect.

Study	Setting and setup	Reported result	Relevance and boundary
Sharma [12]	Private-bank employee study in Rajasthan; reported n = 400; SPSS 22, regression, factor analysis and ANOVA.	Reports HRIS support for workflow automation, training, communication, and employee productivity.	Locally relevant thesis; reported sampling counts need reconciliation; not a CRM deployment trial.
Sultana et al. [6]	Goalpara, Assam; 24 employees from eight branches; BSQ-based items, descriptive and Garrett ranking analysis.	Timeliness, trustworthy behaviour, quality, and convenience rank as important service factors.	Direct Indian private-bank context; small ranking study rather than controlled intervention.
Fekadu and Walia [7]	16 Ethiopian private banks; abstract reports 448 employees and customers; questionnaire and AMOS SEM.	E-HRM relates positively to employee performance and service quality; partial mediation is reported.	Closest service mechanism; sample wording is reproduced at abstract level without assuming 448 in each group.

The studies should not be pooled as if they measured an identical outcome. A customer's assessment of staff knowledge, an employee's satisfaction with HR software, a manager's assessment of CRM, and a simulated case's completion time are different variables. Table 1 therefore compares design and findings without ranking studies by incompatible numerical scales. Where only an abstract or publisher description was accessible, the synthesis is restricted to that information.

Two source-specific qualifications matter. The study by Sultana and colleagues describes its research as experimental, but the reported procedures are employee questionnaires and ranking analysis; an intervention or randomized allocation is not established by that description [6]. Sharma's thesis reports 400 employees while its introductory account also mentions 70 employees from each of six banks, which would imply 420. Its findings are useful background, but those statements cannot be used to reconstruct a verified multi-bank dataset [12].

2.3 Research gap

The reviewed evidence supports investigating the HRIS–employee–service relationship; it does not justify assuming the relationship is absent from prior research. A narrower gap motivates this work: the selected studies do not provide the combination of a questionnaire-aligned implementation, explicit input-quality controls, a reproducible eligibility rule, and a sensitivity analysis of service delay under alternative staffing and mismatch assumptions. This gap concerns implementation transparency and evaluation, rather than a claim that HRIS and CRM have never been studied together.

Common-source perceptions also require caution. When employees evaluate both a technology and its claimed outcomes in the same questionnaire, the resulting associations may reflect shared measurement processes as well as substantive relationships [11]. A review report therefore needs to preserve the distinction between a favourable perception, a verified competence, and an observed service outcome. The prototype adopts that separation even in its demonstration.

III. PROPOSED METHODOLOGY

3.1 Study design and evidence boundaries

The design combines artifact construction with two evaluation layers. Layer A is a deterministic reanalysis of a supplied questionnaire matrix. It establishes that item mapping, numerical calculations, and quality diagnostics operate as specified. Layer B is a controlled discrete-event routing simulation using separately generated staff and service cases. It examines operational trade-offs under fully stated assumptions. The questionnaire matrix does not calibrate the arrival process, service duration, staff skills, or mismatch penalties in Layer B.

The questionnaire contains six scored domains: HRIS effectiveness, HR management practices, training and development, employee performance, perceived HRIS contribution to CRM, and organizational support. Item counts are 6, 6, 5, 5, 6, and 6, respectively, giving 34 scored items. The statement “35 structured items” in the questionnaire is treated as a counting error. Seven demographic questions and three open-ended questions are separate components; the response table does not contain their answers.

Table 2. Construct operationalization and corresponding implementation responsibilities

Domain	Items	Content represented	Implementation responsibility
HRIS	HRIS1–HRIS6	Usability, productivity, accuracy, paperwork, decisions, integration.	Validate information and define the integration boundary.
HRM	HRM1–HRM6	Recruitment, training, appraisal, promotion, grievances, motivation.	Produce candidate HR-process reviews.

Domain	Items	Content represented	Implementation responsibility
TD	TD1–TD5	Customer handling, training needs, performance, digital learning, refreshers.	Connect reviews to training and skill-verification plans.
EP	EP1–EP5	Monitoring, productivity, speed, errors, communication.	Define measurable performance checks for future fieldwork.
CRM	CRM1–CRM6	Service, information access, complaints, response time, personalization, satisfaction.	Distinguish employee perceptions from CRM event outcomes.
OS	OS1–OS6	Management support, technical help, encouragement, upgrades, security, satisfaction.	Define ownership and operational support for the service.

3.2 Ingestion and quality assurance

The response table is extracted from the Word source into a row-oriented file while retaining its identifiers. The parser requires the identifier and all 34 expected items, and rejects unexpected columns, duplicate identifiers, missing fields, nonnumeric entries, nonfinite values, fractional scores, and scores outside 1–5. It checks values before converting them to integer scores. No imputation, reverse scoring, or silent deletion is applied to the demonstration matrix. Two classes of diagnostic are kept separate. Invalid schema or invalid values stop the analysis. Repeated answer vectors, constant response rows, and unused response categories are reported as warnings because they can exist in syntactically valid data. All original rows remain in the primary description; unique-pattern and nonconstant subsets are evaluated

separately. A duplicate pattern does not establish a duplicate person, and a constant row does not establish inattentive responding. Here the diagnostics characterize known construction.

3.3 Scoring and statistical diagnostics

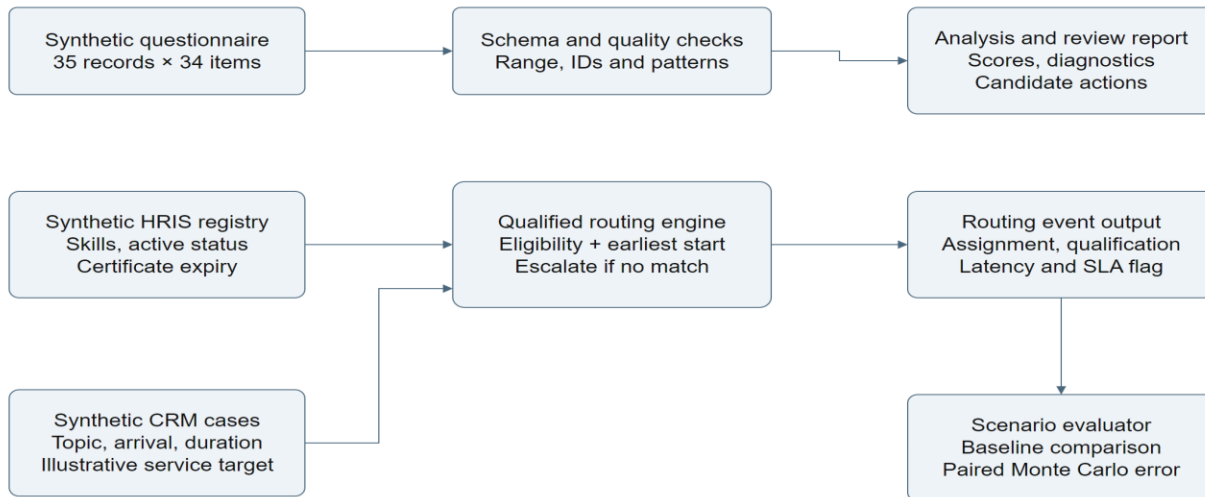
For record i and construct k , the score C_{ik} is the arithmetic mean of the m_k items mapped to that construct. Each item receives equal weight within its construct. The construct mean is the average of those record scores. Standard deviations use the sample divisor $n - 1$. The top-box percentage counts item responses equal to 5 within each construct and divides by $n \times m_k$. Thus, top-box percentages describe item cells, not the percentage of employees who are satisfied.

Internal consistency is calculated as $\alpha = m/(m - 1) \times [1 - \text{sum of item variances} / \text{variance of the item total}]$. Pearson correlations describe linear comovement between construct averages; Spearman correlations provide a rank-based comparison using average ranks for ties. A simple least-squares line predicts the CRM score from the HRIS score for demonstration. No p-values, population confidence intervals, mediation tests, or causal hypothesis acceptances are attached to this constructed dataset.

Sensitivity analysis repeats HRIS–CRM associations after retaining one copy of each distinct vector, after excluding constant rows, and within odd and even identifier groups. The last split is a diagnostic of the ordering visible in the records. It is not a demographic subgroup analysis or a recommended substantive control variable.

3.4 Review priorities and routing architecture

The review module computes the distance from each construct mean to the upper scale anchor. Constructs with a mean below a configurable threshold are listed in ascending mean order. A default threshold of 4.6 is used solely to demonstrate rule execution; it is not a validated standard. Each listed construct maps to a candidate process review. Managers would need independent evidence before selecting an intervention. Survey scores never determine an individual employee's competence, eligibility, appraisal, or assignment.



Survey scores inform human review only; they do not determine staff eligibility or customer case routing.

Figure 3. Implemented offline architecture. Survey analysis and service routing are separate paths. All input data; external HRIS and CRM integrations remain future work.

The routing path uses a separate registry containing employee ID, active status, a set of eligible topics, and a certificate-expiry time. A service case contains a case ID, topic, arrival time, simulated base duration, and an illustrative completion target. These are minimal research fields. In a future deployment, the HRIS would remain authoritative for workforce eligibility, while CRM would remain authoritative for customer and case records. Only the minimum eligibility information would pass between them.

3.5 Assignment process and performance measures
Cases are processed in arrival order. For each employee, the engine calculates the earliest assignment start as the larger of case arrival and the employee's next-free time. Qualified routing retains only active employees who possess the required topic and whose certificate remains valid at that start. The selected employee has the earliest start; stable employee ID breaks ties. If no eligible employee exists, the engine emits ESCALATE and leaves the case unassigned. A separate human process would handle that queue.

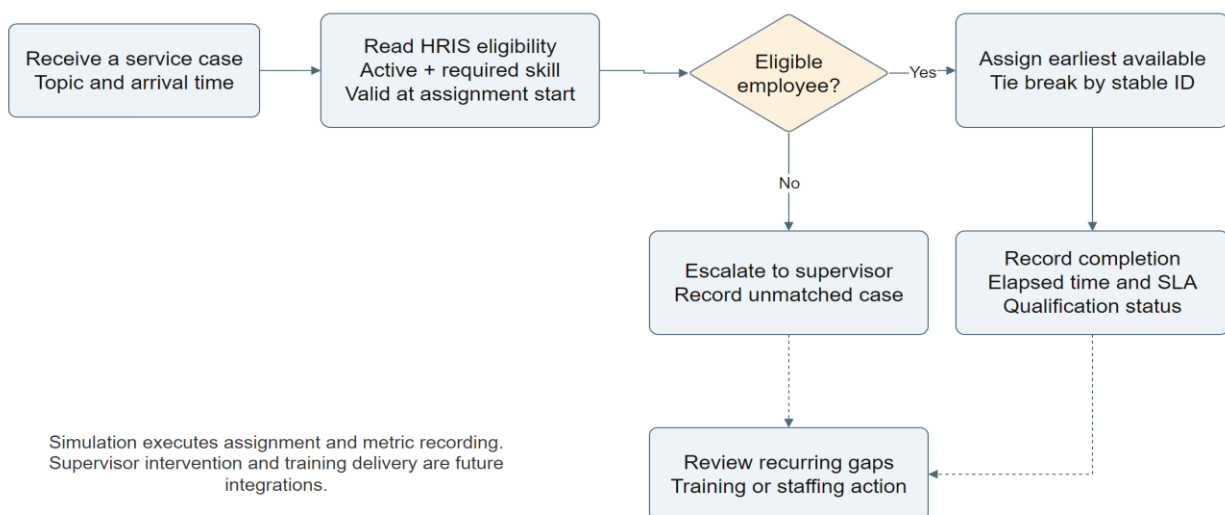


Figure 4. Service-assignment process with qualification checks, escalation, and recorded outcomes. Dashed review paths indicate future supervisory and training integrations.

The comparison baseline chooses the earliest available active employee without inspecting skills or certificate validity. This intentionally simple baseline isolates the value and cost of eligibility filtering; it is not presented as the current operating policy of any bank. Both policies receive the same staff registry, arrival sequence, topics, and base durations within a replication. A qualified assignment consumes the base duration. An unqualified baseline assignment consumes the base duration plus an assumed mismatch penalty. The penalty represents additional service effort, not an observed error rate or a separate measured complaint.

Elapsed service time equals completion time minus arrival time, so it includes waiting. Service-target attainment is the proportion of all arriving cases completed within 20 simulated minutes. Escalated cases count as nonattaining. Qualified-assignment coverage is qualified assignments divided by all arriving cases. Mean elapsed time is calculated among completed cases and must be read alongside escalation frequency. The simulated target is an experimental parameter, not a bank commitment or a regulatory deadline.

3.6 Experimental execution and reproducibility

The simulation crosses two additional-skill probabilities, two arrival intervals, and three mismatch penalties. There are 12 employees and three case topics. Every employee has one primary topic, distributed evenly across the workforce. Each other topic is added independently with probability 0.1 or 0.6. All employees are active and certificates remain valid in the main simulation; inactive and expired records are addressed by functional tests. Equal topic probabilities avoid introducing a hidden topic imbalance.

Each scenario is run for seeds 7300–7329, with 500 cases per seed. Arrivals have exponential interarrival times with means of 0.75 or 1.5 minutes. Base durations follow a lognormal distribution with log-scale standard deviation 0.35 and log-scale mean $\ln(8) - 0.35^2/2$, giving an arithmetic mean of eight minutes. Mismatch penalties are 0, 6, or 12 minutes. Each run begins with an empty system and ends after every generated case has been assigned or escalated; the simulation has no working-day cutoff or warm-up deletion.

For each seed, the difference in service-target percentage between the proposed policy and baseline is calculated. The scenario estimate is the mean of 30 paired differences, and its Monte Carlo standard error is the sample standard deviation of those differences divided by the square root of 30. Graphical uncertainty bars use the mean plus or minus 1.96 standard errors. They express variability across simulated replications, not uncertainty about actual banks. Inputs, code, seed values, intermediate summaries, and diagram sources are retained for rerunning the evaluation.

IV. EXPERIMENTAL SETUP RESULTS AND DISCUSSION

4.1 Data provenance and source reconciliation

The project inventory contains 51 original files. Three files in the report folder are byte-identical to their counterparts in the research folder, and the thesis-response archive repeats those documents. The CRM archive likewise repeats the five extracted PDF studies. These copies are not additional data. Other project material includes HRIS reviews, published studies, theses, educational questionnaires and datasets, publication forms, and image-based documents. Only the employee table provides row-level values for the six constructs used in this implementation.

Table 3. Evidence audit and decisions affecting the results

Material or issue	Observation	Treatment in this paper
Employee response table	35 IDs; 34 scored columns; 1,190 item values.	Use as a fixed test fixture, never as field observations.
Employee questionnaire	Six item groups total 34, although its summary states 35.	Use the actual item codes; retain demographics and open-ended items as unpopulated.

Material or issue	Observation	Treatment in this paper
Thesis narrative	Reports $n = 250$, multiple banks, and perfect correlations; underlying matching row-level data are not present.	Do not reproduce those values as verified results.
Repeated report and research files	Identical content and hashes; archive copies also match.	Count the matrix once.
HRIS and CRM studies	Secondary literature with different samples and instruments.	Use for contextual review, not as records in this analysis.
Education data and publication forms	Different population, purpose, or administrative content.	Exclude from HRIS–CRM computation.

Consequently, this study reports no response rate, branch coverage, recruitment dates, demographic distribution, consent event, or ethics approval as an accomplished empirical fact. Those elements belong to a future field protocol. The generator, calibration procedure, and seed of the supplied 35-row matrix are unknown. Its exact stored values can nevertheless be reprocessed and their numerical properties verified.

4.2 Software and simulation configuration

Table 4. Executed environment and experimental parameters

Component	Configuration
Survey fixture	35×34 values; six equal-item-weight construct scores; no missing-value imputation.

Component	Configuration
Routing workforce	12 simulated employees; three primary-topic groups of four employees; all active in the main experiments.
Skill coverage	Every employee has a primary topic; each additional topic has independent probability 0.1 or 0.6.
Arrival and duration	Exponential interarrivals: mean 0.75 or 1.5 min; lognormal base duration: mean 8 min, log-SD 0.35.
Costs and target	Mismatch penalty: 0, 6, 12 min; illustrative completion target: 20 min from arrival.
Repetition	12 scenarios $\times$ 30 seeds $\times$ 500 cases; two paired policies; 720 policy runs and 360,000 case-policy evaluations.
Initialization and uncertainty	Empty system; no warm-up deletion; report paired Monte Carlo standard errors, not field confidence intervals.
Functional verification	18 named checks for input validity, quality flags, eligibility, expiry, escalation, and SLA boundaries.

The test measures algorithmic behaviour rather than software throughput. Reported minutes are simulated service times, not wall-clock execution measurements. The implementation is small enough to run locally, but no claim is made about production latency, concurrency, fault tolerance, or integration capacity. Static registries and known next-free times deliberately simplify the assignment problem. The no-penalty scenario tests whether the proposed rule still helps when qualification has no time advantage, avoiding an experiment that guarantees favourable results by construction.

4.3 Response distribution and data-quality findings

Table 5. Diagnostics of the questionnaire matrix

Diagnostic	Result	Interpretation
Valid item cells	1,190 / 1,190	All values satisfy the schema and 1–5 integer range.
Response category 4	478 cells; 40.17%	Agree is one of only two observed response categories.

Diagnostic	Result	Interpretation
Response category 5	712 cells; 59.83%	Top-box concentration limits distributional realism.
Categories 1–3	0 cells	No disagreement or neutral response is represented.
Distinct response vectors	30 of 35	Five excess copies across two repeated-pattern groups.
Constant response vectors	7 of 35; 20.00%	Five all-5 rows and two all-4 rows.
Demographic and open responses	Absent	No subgroup claims or qualitative themes can be calculated.

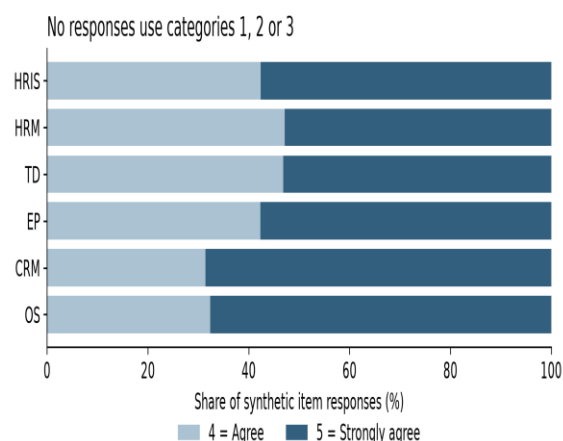


Figure 5. Distribution of categories 4 and 5 within each construct. Denominators are item cells: 210 for six-item constructs and 175 for five-item constructs. The repeated all-5 vector occurs in E05, E15, E25, E31, and E35; the all-4 vector occurs in E10 and E30. The remaining 28 rows vary within the narrow 4–5 range. An “agreement rate” based on scores of at least 4 would be 100% for every item and would carry virtually no discriminating information. The pipeline therefore reports the full category distribution, top-box shares, and pattern counts rather than describing universal agreement as evidence of successful HRIS adoption.

These features are especially useful as software test cases: a valid schema can coexist with unrealistic or

highly structured response patterns. They do not justify an allegation about respondents because there are no observed respondents in this dataset. In later fieldwork, the same flags would trigger an audit of capture and coding processes, followed by a documented sensitivity analysis rather than automatic deletion.

4.4 Construct scores and internal consistency

Table 6. Descriptive calculations on 35 records

Construct	Items	Mean	SD	Median	Alpha	Top box %
HRIS	6	4.576	0.324	4.667	0.729	57.62
HRM	6	4.529	0.354	4.500	0.797	52.86
TD	5	4.531	0.343	4.600	0.717	53.14
EP	5	4.577	0.328	4.800	0.669	57.71
CRM	6	4.686	0.310	4.833	0.743	68.57
OS	6	4.676	0.310	4.833	0.749	67.62

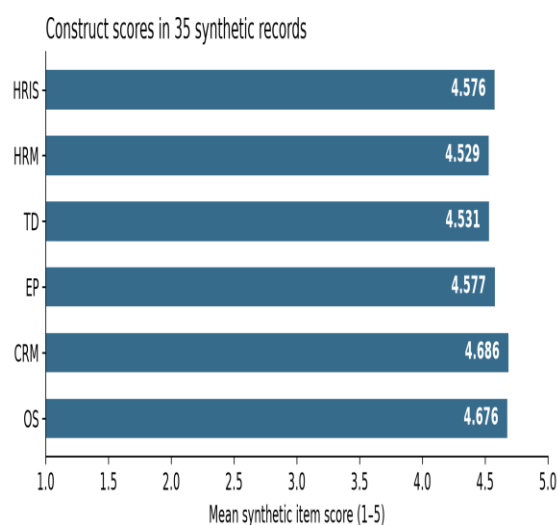


Figure 6. Mean scores for the six constructs on the original 1–5 scale. Values are descriptive calculations, not estimates of bank or employee performance.

CRM has the highest mean, 4.686, followed by organizational support at 4.676. HRM has the lowest mean, 4.529, followed closely by training and development at 4.531. The total spread between the highest and lowest construct means is only 0.157 scale points. Such small differences within a deliberately favourable fixture cannot support a substantive ranking of HR priorities in actual banks. They are sufficient to demonstrate that the implementation calculates and orders construct summaries consistently.

Calculated alpha values range from 0.669 for employee performance to 0.797 for HRM. Even a value that would often be considered numerically acceptable does not validate an instrument using data. Alpha depends on the covariance pattern supplied to the calculation; it does not establish unidimensionality, distinct constructs, truthful answers, or external validity. The EP value is retained rather than increasing alpha through retrospective item removal. No factor model is fitted to a 35-row matrix as evidence of measurement validation.

4.5 Associations and sensitivity to constructed patterns

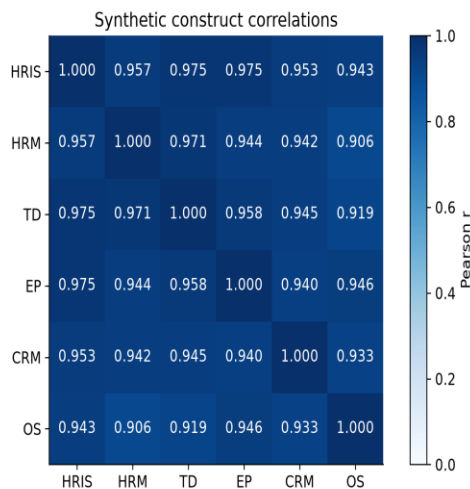


Figure 7. Pearson correlations among construct averages. Strong co-movement reflects the properties

of the fixture and is not an empirical test of the HRIS–CRM relationship.

The HRIS–CRM Pearson correlation is 0.953 and the corresponding Spearman correlation is 0.939. Across the six constructs, off-diagonal Pearson correlations range from 0.906 to 0.975. A demonstration regression gives $CRM = 0.519 + 0.911 \times HRIS$, with in-sample $R^2 = 0.908$ and $RMSE = 0.093$ scale points. These are fitted properties of constructed records. They do not imply that HRIS explains 90.8% of actual CRM outcomes, that a one-unit intervention would produce the fitted change, or that the model will predict new bank observations.

Table 7. HRIS–CRM sensitivity diagnostics on subsets

Subset	n	HRI S mean	CR M mean	Pearso n r	Spearma n rho
All records	35	4.576	4.686	0.953	0.939
Unique patterns	30	4.539	4.667	0.947	0.937
Nonconstant records	28	4.542	4.679	0.942	0.931
Odd numbered IDs	18	4.861	4.944	0.588	0.577
Even numbered IDs	17	4.275	4.412	0.863	0.837

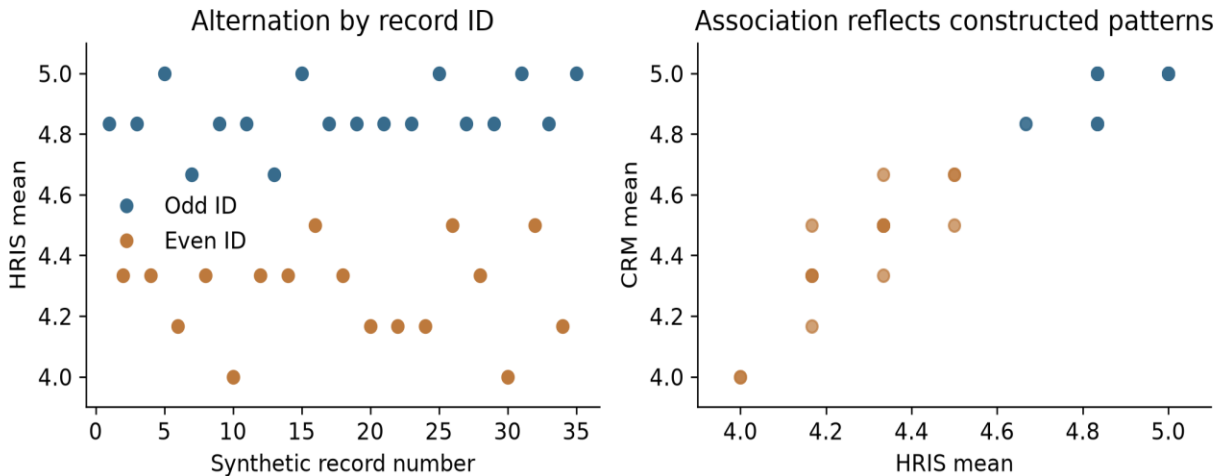


Figure 8. Ordering diagnostic for the matrix. Odd identifiers tend to have higher scores than even identifiers; overplotted points represent repeated construct pairs.

Deduplication and removal of constant rows leave large correlations, at 0.947 and 0.942. This persistence does not rescue the relationship as field evidence; similar structure remains in the nonconstant rows. Splitting by identifier parity reveals more of that construction. Odd IDs have mean HRIS 4.861 and mean CRM 4.944, compared with 4.275 and 4.412 for even IDs. The within-group Pearson coefficients are 0.588 and 0.863. The pooled relationship therefore combines differences between the constructed groups with variation within them.

The broader methodological implication is that numerical consistency can coexist with weak evidential meaning. In real employee questionnaires, shared wording and source effects would add further interpretive risks [11]. The present artifact makes the origin and diagnostic patterns visible before presenting correlations. An automated report that printed a large coefficient without its data status would be misleading even if the calculation itself were correct.

5.6 Implemented review outputs and functional checks

Table 8. Candidate review actions generated at the illustrative threshold of 4.6

Order	Construct	Mean	Gap to 5	Generated review action
1	HRM	4.529	0.471	Review appraisal and grievance workflows.
2	TD	4.531	0.469	Review refresher and customer handling training.
3	HRIS	4.576	0.424	Review usability and integration mapping.
4	EP	4.577	0.423	Review error prevention and communication.

Order	Construct	Mean	Gap to 5	Generated review action
1	HRM	4.529	0.471	Review appraisal and grievance workflows.
2	TD	4.531	0.469	Review refresher and customer handling training.
3	HRIS	4.576	0.424	Review usability and integration mapping.
4	EP	4.577	0.423	Review error prevention and communication.

This output is a transparent rule demonstration. At threshold 4.5 no construct is listed; at 4.6 four are listed; at 4.7 all six are listed. The apparent action count is therefore sensitive to a managerial parameter, not a discovery of four verified deficiencies. HRM and TD differ by approximately 0.003 points, too little to justify treating their numerical order as a substantive priority. In field use, branch-level case evidence, staff consultation, and operational risk would guide the decision.

Table 9. Executed functional checks grouped by purpose

Check group	Checks	Result
Valid ingestion	Accept the original 35×34 matrix.	1 / 1 passed
Invalid-input rejection	Missing item, out-of-range score, fractional score, duplicate ID, text score, empty score, NaN, unexpected field.	8 / 8 passed
Quality diagnostics	Detect seven constant rows and two repeated-pattern groups.	1 / 1 passed
Eligibility and routing	Qualified selection, baseline mismatch, inactive exclusion, expired certificate, expiry before start, missing skill.	6 / 6 passed
Service-target boundaries	Completion exactly at 20 minutes passes; completion at 21 minutes fails.	2 / 2 passed
Total	Named deterministic checks retained with machine-readable results.	18 / 18 passed

An inspectable four-case trace supplies a concrete example. With two active employees, S01 eligible for topic 0 and S02 for topic 1, a topic-1 case goes to S02 and a topic-0 case to S01. A topic-2 case escalates because neither employee qualifies. A second topic-1 case waits for S02 and completes after 16 minutes when both service durations are eight minutes. This trace demonstrates eligibility, waiting, and escalation without assigning real customers or contacting an HR system.

4.7 Simulation results across all scenarios

Table 10 reports the complete 12-scenario comparison. Each percentage is the mean of 30 run-level percentages, each based on 500 cases. The paired difference subtracts the workload-only percentage from the qualified-routing percentage. Cross-skill probability refers to each additional topic, not to the percentage of trained employees. Shorter interarrival time represents heavier offered workload. All main-simulation cases have at least four employees with the required primary topic, so escalation is zero for both policies in these runs.

Table 10. Simulated completion-target attainment and paired Monte Carlo uncertainty

Extra skill p	Arrival min	Penalty min	Baseline %	Qualified %	Diff pp	MCS E pp
0.1	0.75	0	98.28	87.33	-10.95	1.50
0.1	0.75	6	10.85	87.33	+76.48	1.75
0.1	0.75	12	3.95	87.33	+83.37	1.54
0.1	1.50	0	99.75	99.71	-0.04	0.01
0.1	1.50	6	97.09	99.71	+2.61	0.18
0.1	1.50	12	64.31	99.71	+35.39	1.47
0.6	0.75	0	98.28	97.86	-0.42	0.12
0.6	0.75	6	58.33	97.86	+39.53	4.79
0.6	0.75	12	27.07	97.86	+70.79	3.36
0.6	1.50	0	99.75	99.75	+0.00	0.00
0.6	1.50	6	98.92	99.75	+0.83	0.08
0.6	1.50	12	90.41	99.75	+9.34	0.52

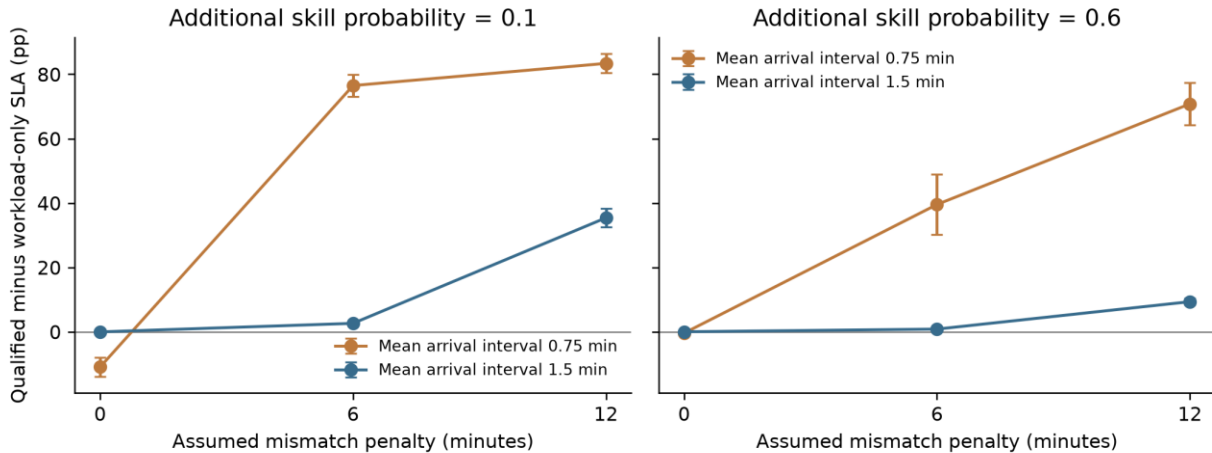


Figure 9. Sensitivity of the simulated service-target difference to mismatch penalty, workload, and additional-skill coverage. Bars show ± 1.96 paired Monte Carlo standard errors across 30 runs; pp denotes percentage points.

At additional-skill probability 0.1 and a 0.75-minute arrival interval, qualified routing attains 87.33% across all penalties. The baseline attains 98.28%, 10.85%, and 3.95% when penalties are 0, 6, and 12 minutes, respectively. Qualified routing avoids the assumed mismatch penalty but restricts the eligible pool. Its disadvantage of 10.95 percentage points in the zero-penalty condition is an important boundary result: enforcing qualifications can increase waiting when the simulation assigns no time cost to mismatches.

With a six-minute penalty in that same scenario, the paired advantage is 76.48 percentage points, with Monte Carlo standard error 1.75 points. This large simulated improvement is driven by congestion. The unpenalized offered load is approximately $8/(12 \times 0.75) = 0.889$ of total nominal service capacity. The workload-only policy assigns many cases outside the selected employee's skills. Adding service effort to those cases pushes the system toward overload, producing a queue that grows during the finite run. The result is a stress-test consequence of the assumptions, not a plausible percentage improvement established for Indian banks.

At the lighter 1.5-minute arrival interval, the same six-minute penalty produces a smaller difference of 2.61 points with sparse additional skills and 0.83 points with broader additional skills. When additional-skill probability is 0.6, the proposed policy attains 97.86% under heavy arrivals and 99.75% under light arrivals. Broad skill coverage reduces the waiting cost of filtering. The zero-penalty condition

shows a 0.42-point loss under heavy arrivals and no observed attainment difference under light arrivals.

4.8 Qualification coverage and elapsed time

Table 11. Simulated qualification coverage and mean elapsed time for the six-minute penalty

Extra skill p	Arrival min	Qualified coverage baseline %	Qualified coverage proposed %	Elapsed baseline min	Elapsed proposed min
0.1	0.75	41.35	100.00	60.94	12.74
0.1	1.50	41.79	100.00	11.69	8.21
0.6	0.75	77.62	100.00	20.07	9.99
0.6	1.50	77.43	100.00	9.40	8.04

In the main simulation, qualified-assignment coverage is 100% by construction for the proposed rule because the registry is assumed accurate and eligible primary-topic staff always exist. This is a verified invariant of the simplified algorithm, not a measured error-free customer-service rate. Under the six-minute penalty, baseline qualification coverage ranges from 41.35% to 77.62%. Mean elapsed time ranges from 9.40 to 60.94 minutes for the baseline and from 8.04 to 12.74 minutes for the proposed policy across the four workload and skill settings.

The rule's independence from the penalty is also intentional. Once every proposed assignment is qualified, the model never applies its mismatch penalty. Differences across the three penalty settings come from the baseline. This controlled comparison isolates an assumption that a real deployment would have to measure: the added effort, delay, risk, or transfer burden associated with assigning a request without the relevant competence. A zero penalty is not an assertion that competence does not matter; it is a useful adverse condition for testing the implementation's claims.

4.9 Discussion and implementation implications

The results answer the three research questions at different levels. RQ1 is answered by correct ingestion, visible data-quality warnings, and reproducible construct summaries. RQ2 is answered by the executable eligibility and escalation logic plus its boundary checks. RQ3 is answered conditionally: qualified routing helps simulated target attainment when avoiding assumed mismatch effort outweighs the queueing cost of restricting assignments. It can lose on timeliness when that effort is absent and the eligible pool is narrow.

These finding complements, rather than verifies, the employee-service mechanism in the literature. Knowledgeable staff are relevant to CRM [3], while employee performance has been examined as a mediator between E-HRM and service quality [7]. The experiment translates one part of that broad mechanism into a service rule, but it does not simulate customer trust, employee motivation, complaint fairness, or relationship retention. Those outcomes require their own measures and cannot be inferred from a 20-minute completion flag.

A practical implementation should therefore treat HRIS as a source of operational capability information, with training and workload planning as complementary processes. Maintaining qualifications without sufficient coverage may create bottlenecks. Increasing nominal coverage without verifying competence may make routing appear successful while degrading service quality. The present prototype does not optimize training allocation; it identifies the operational reason to evaluate training coverage and case outcomes together.

Table 12. Proposed field measurements for subsequent bank validation

Outcome	Operational definition	Required evidence
First-contact resolution	Cases closed without transfer or reopening within a prespecified follow-up period / eligible case.	CRM event history and consistent closure definitions.
Completion and waiting time	Arrival-to-start and arrival-to-final-resolution durations, reported separately.	Time-stamped events, business-time calendars, case type.
Verified skill coverage	Assigned cases meeting the approved topic-specific competence requirement / assigned cases.	Current HRIS competence records and a maintained topic map.
Customer experience	Post-interaction satisfaction using a fixed instrument and documented response denominator.	Customer survey linked to cases with appropriate permission.
Training outcome	Change in assessed competence and case outcomes after a defined intervention.	Training dates, independent assessments, baseline and follow-up.
Operational burden	Transfers, rework effort, supervisor escalations and staffing cost per case.	Event logs, time measures and approved cost definitions.

The appropriate next evaluation is a prospectively specified branch or team pilot with pre-intervention measurements and a concurrent comparison group. Bank and branch identifiers, case type, volume, channel, and calendar period should be retained so changes in workload are not mistaken for treatment effects. Where random allocation is feasible, a cluster design can reduce contamination between staff who share work. Otherwise, an explicitly justified quasi-experimental design should examine pre-trends and

concurrent changes. A sample size should follow the primary outcome, expected effect, branch clustering, and attrition assumptions; a universal target such as 250 is not a substitute for that calculation.

V. CONCLUSION RESEARCH GAP LIMITATIONS AND FUTURE WORK

5.1 Conclusion

This paper implements a traceable approach for connecting HRIS-related information to CRM service standards in an intended Indian private-bank context. Its achieved outputs are an executable validation and review pipeline, explicit qualification-based routing, 18 passing functional checks, and a reproducible 12-scenario simulation. The evaluation demonstrates both the benefit of avoiding assumed mismatch effort and the delay introduced by a restricted eligible workforce. HRIS-informed service design should therefore assess capability, skill coverage, and workload together.

The questionnaire matrix yields favorable means and strong interconstruct associations, but those statistics establish neither employee satisfaction nor an HRIS effect on CRM. The meaningful result of that exercise is the ability to reproduce calculations while exposing ceiling concentration, repeated vectors, and identifier-related structure. Treating those diagnostics as part of the implementation prevents a technically correct analysis from being presented as empirical proof.

5.2 Research gap addressed and remaining limitations

The addressed gap is the lack, within the reviewed works, of this combined questionnaire-to-artifact evaluation with explicit service-rule assumptions and negative-condition testing. The larger empirical gap remains open: whether verified HRIS capabilities improve independently measured customer outcomes across selected private sector commercial banks in India. The present study supplies a method for investigating that question, not an answer derived from Indian field data.

Several limitations constrain interpretation. The supplied matrix is small, restricted to categories 4 and 5, and generated by an undocumented process. Its demographic and qualitative fields are absent. The simulation assumes accurate, static skills;

continuously active staff; independent case arrivals and durations; equally likely topics; and an initially empty system. It omits priority classes, employee learning, fatigue, absences, multi-step referrals, customer abandonment, stale records, and changing competence. Heavy-load runs can build persistent queues because there is no day-end cutoff. Reported performance is specific to these assumptions.

The workload-only baseline is deliberately limited, while the proposed policy knows eligibility perfectly. Neither represents a calibrated bank operation. Tests establish the listed functional behaviours but do not establish secure production integration, robustness to all inputs, or service quality outside the simulation. Thirty replications quantify Monte Carlo variability for the chosen scenarios; they cannot quantify uncertainty about the realism of the model. The review is narrative and does not support an exhaustive novelty claim.

5.3 Future work

Future work should first obtain a documented, consented employee and customer dataset and revise ambiguous questionnaire wording. For example, customer information should be located in CRM, while HRIS contributes workforce eligibility; an item attributing customer-information access directly to HRIS needs cognitive testing. Distinct constructs should be validated on an adequate field sample, using independently sourced outcomes where possible. Common-source remedies should be designed into collection rather than assumed from high alpha values [11].

The next implementation stage should add time-stamped skill updates, topic-specific certificate expiry, staff availability, validated case classifications, and a managed escalation queue. Simulation should be calibrated to observed arrival and service distributions and compared with actual routing practice, including an experienced-manager or existing-rule baseline. Experiments should add topic imbalance, stale credentials, absence shocks, shift boundaries, skill-specific durations, and unequal training costs. A subsequent controlled pilot can then test whether service gains are sustained, whether customer experience improves, and whether benefits justify implementation and maintenance effort.

REFERENCES

- [1] Bondarouk, T. V., & Ruël, H. J. M. (2009). Electronic human resource management: Challenges in the digital era. *The International Journal of Human Resource Management*, 20(3), 505–514.
<https://doi.org/10.1080/09585190802707235>
- [2] DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems*, 19(4), 9–30.
<https://doi.org/10.1080/07421222.2003.11045748>
- [3] Rootman, C., Tait, M., & Bosch, J. (2007). The influence of bank employees on bank customer relationship management. *Acta Commercii*, 7(1), Article a28. <https://doi.org/10.4102/ac.v7i1.28>
- [4] Malhotra, N., & Mukherjee, A. (2004). The relative influence of organizational commitment and job satisfaction on service quality of customer-contact employees in banking call centres. *Journal of Services Marketing*, 18(3), 162–174.
<https://doi.org/10.1108/08876040410536477>
- [5] Wang, Y.-C., & Yang, Y.-F. (2015). The impact and interaction effect of HR and IT applications on the performance of customer relationship management in the banking industry: An empirical study of five Taiwanese banks. *Information Resources Management Journal*, 28(3), 29–41.
<https://doi.org/10.4018/IRMJ.2015070103>
- [6] Sultana, M., Mpanme, D., & Ahmed, J. U. (2022). Customer relationship management practices and employee sensitivities of private sector banks: An analysis in Indian context. *Business and Economic Research*, 12(4), 168–182. <https://doi.org/10.5296/ber.v12i4.20426>
- [7] Fekadu, M., & Walia, N. (2024). E-HRM as a strategic enabler of service excellence: Empirical evidence from Ethiopian private banks. *Journal of Logistics, Informatics and Service Science*, 11(8), 401–418.
<https://doi.org/10.33168/JLISS.2024.0823>
- [8] Bondarouk, T., Parry, E., & Furtmueller, E. (2017). Electronic HRM: Four decades of research on adoption and consequences. *The International Journal of Human Resource Management*, 28(1), 98–131.
<https://doi.org/10.1080/09585192.2016.1245672>
- [9] Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75–105.
<https://doi.org/10.2307/25148625>
- [10] Morris, T. P., White, I. R., & Crowther, M. J. (2019). Using simulation studies to evaluate statistical methods. *Statistics in Medicine*, 38(11), 2074–2102.
<https://doi.org/10.1002/sim.8086>
- [11] Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
<https://doi.org/10.1037/0021-9010.88.5.879>
- [12] Sharma, A. (2018). Impact of human resource information system in private banking sector [Doctoral dissertation, The IIS University, Jaipur].
- [13] Valmohammadi, C. (2014). Customer relationship management and service quality, a survey within the banking sector. *Industrial and Commercial Training*, 46(2), 77–83.
<https://doi.org/10.1108/ICT-08-2013-0056>