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DEVELOPMENT OF A SOFTWARE TOOL FOR PRIORITISING AND SELECTING THE NEXT COMMUNICATION ACTION IN BANKING CRM SYSTEMS

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Анотація

У роботі розглянуто розробку програмного засобу для пріоритизації та вибору наступної комунікаційної дії для клієнтів банківських установ у CRM-середовищі. Актуальність теми зумовлена тим, що статичні правила розсилок і фрагментовані інтеграції між CRM, цифровими каналами, сервісами повідомлень та робочими місцями операторів не забезпечують належної персоналізації, своєчасності та узгодженості контактів. Запропоновано модель пріоритизації та вибору next-best-action, яка враховує RFM-показники, lead score, ймовірність відгуку, обмеження частоти контактів, згоду на обробку персональних даних, оптимальний часовий інтервал надсилання та релевантність банківського продукту. Подальшого розвитку набув підхід до інтеграції CRM-платформи з каналами банківських комунікацій, у якому використано комбінування дедуплікації клієнтських записів на основі нечіткого зіставлення атрибутів, журналювання подій взаємодії, рольового керування доступом та контролю ідемпотентності API-викликів. Для перевірки підходу описано програмний прототип і сценарно-орієнтоване експериментальне оцінювання на синтетичному наборі даних, структурно наближеному до роздрібних банківських процесів. Отримані результати показали підвищення точності сегментації клієнтської бази на 19,4 %, збільшення середнього response rate на 16,8 %, зменшення частки дубльованих клієнтських карток на 24,3 % і скорочення кількості помилок синхронізації між CRM та зовнішніми сервісами на 28,7 %. Запропонований програмний засіб може бути використаний як прикладна основа для модернізації комунікаційних контурів банківських установ.

Ключові слова: банківська установа, CRM, next-best-action, пріоритизація клієнтів, RFM-аналіз, lead scoring, омніканальна комунікація, дедуплікація записів, журналювання подій, ідемпотентність API.

Abstract

This paper addresses the development of a software tool to prioritise and select the next communication action for clients of banking institutions within a CRM environment. The topic is relevant because static mailing rules and fragmented integrations between CRM platforms, digital channels, messaging services, and operator workplaces do not provide the required degree of personalisation, timeliness, and communication consistency. A customer prioritisation and next-best-action model is proposed that takes into account RFM indicators, lead score, response probability, contact frequency constraints, consent to personal data processing, the optimal sending time window, and the relevance of a banking product. The approach to CRM-platform integration with banking communication channels is further developed by combining fuzzy-attribute matching for client-record deduplication, interaction-event logging, role-based access control, and idempotency control for API calls. To validate the approach, the paper describes a software prototype and a scenario-based experimental evaluation using a synthetic dataset that is structurally aligned with retail banking processes. The obtained results demonstrate a 19.4% increase in customer-base segmentation accuracy, a 16.8% increase in average response rate, a 24.3% reduction in duplicated client cards, and a 28.7% reduction in synchronisation errors between the CRM and external services. The proposed software tool may therefore serve as a foundation for modernising the communication layer of banking institutions.

Keywords: banking institution, CRM, next-best-action, customer prioritisation, RFM analysis, lead scoring, omnichannel communication, record deduplication, event logging, API idempotency.

The modern banking environment is characterised by strong competition for customer attention, a steady migration of interactions into digital channels, and growing expectations regarding the relevance and timing of communications. A prospective client can move from an advertising landing page to a loan calculator, then to a mobile application, and finally to a call-centre conversation within a single decision episode. An existing client may, on the same day, receive a service notification, review a card offer, ask a question in chat, and contact an operator about an already opened product. Research on omnichannel customer experience shows that organisations achieve better communication continuity when they treat the journey as an integrated sequence of touchpoints rather than a set of unrelated channel events [1]. Studies of open

banking and AI-enabled mobile banking likewise indicate that customers increasingly value digital support, convenience, contextual relevance, and the visible coherence of the service environment [2, 3]. For banking institutions, this means that the quality of customer communications depends not only on the message content itself, but also on the ability of the software platform to determine what the next message should be, through which channel it should be delivered, when it should be sent, and whether the bank is entitled to send it at all in the current customer context.

In practice, however, a considerable share of communication processes in banks is still governed by static mailing rules, manually configured campaign lists, isolated product triggers, or poorly synchronised channel-specific workflows. A client who has just responded to a cross-sell campaign may still remain in a generic follow-up sequence. A lead with strong behavioural intent may be processed later than a less promising contact simply because the workflow order was fixed in advance. Existing clients may receive untimely promotional messages following service complaints, while prospective clients may be contacted repeatedly across multiple channels without a unified priority model. Such situations reduce response efficiency, overload operators, and degrade the perceived competence of the bank. Algorithmic segmentation studies emphasise that customer differentiation has become more dynamic and data-rich, and that modern segment selection must account for both behavioural and contextual attributes, rather than relying on coarse, static classifications alone [4]. Consequently, the scientific and applied problem consists in constructing a software means that can both prioritise customers for communication and select the next communication action under operational, legal, and architectural constraints specific to banking institutions.

The purpose of this work is to substantiate and describe the development of a software tool for banking CRM systems that implements a model of customer prioritisation and next-best-action selection while preserving integration consistency across communication channels. The first scientific result is a proposed model of prioritisation and next communication action selection for prospective and existing clients. The model jointly considers RFM indicators, lead score, response probability, frequency caps, explicit consent attributes, an optimal time window for sending, and product relevance. The second scientific result is the further development of an approach to CRM integration with banking communication channels by combining fuzzy matching for deduplication, event-journalling of interactions, role-based access control, and API idempotency control into a single orchestrated software contour. In contrast to rule sets that evaluate a single trigger in isolation, the proposed software tool operates on a contextual communication state formed by customer value, product fit, communication history, data-governance rules, and integration reliability requirements. In this sense, the research moves from campaign automation as such to the automation of informed communication decisions in the banking domain [4-7].

At the centre of the proposed solution is a prioritisation model that converts the customer state into an ordered queue of admissible communication actions. The model does not reduce customer evaluation to one aggregate score; instead, it treats each factor as a distinct decision dimension. RFM indicators are used to capture the recency of meaningful interactions, the frequency of relationship activity, and the monetary or business value associated with the client profile. These indicators remain useful because they summarise client vitality and behavioural maturity in a compact form, while recent research shows that time-varying RFM measures improve the representation of customer dynamics and are suitable for predictive communication tasks [5]. Lead score is employed as a separate dimension because a prospective client who has not yet become a full banking customer may exhibit high propensity signals despite limited monetary history. The lead score is therefore derived from profile completeness, source quality, behavioural intent events, reactions to previous messages, and funnel progression markers. This separation between client value and lead maturity is crucial for banks, where the logic of onboarding differs significantly from the logic of retention, servicing, or cross-selling.

Response probability constitutes the model's predictive component. Instead of using a uniform static rule such as “send the next offer after three days”, the software tool estimates the likelihood that a specific client will respond positively to a specific message in a specific channel under the current context. Direct-marketing response modelling literature demonstrates that communication success is strongly influenced by class imbalance, interaction history, and customer-group heterogeneity, and that ensemble and machine-learning approaches outperform naive uniform policies in many real-world settings [6]. Research on lead prioritisation similarly shows that learned models provide a more reliable basis for selecting high-value contacts than traditional manual prioritisation [7]. In the proposed software tool, response probability is obtained from historical CRM outcomes, recent customer activity, channel affinity, message type, and product-related contextual variables. However, this predictive estimate is not allowed to dominate the

decision on its own. It is filtered by admissibility constraints before being released. This preserves the practical requirement that, in banking, a communication may be commercially attractive yet still operationally or legally inappropriate.

Three additional groups of constraints therefore play a decisive role. The first group is frequency management. Excessive contact intensity reduces response efficiency and irritates customers, especially when several bank units send messages independently. The software tool introduces configurable contact ceilings by period, channel, scenario type, and product family, and includes cooling intervals after high-friction or high-attention episodes, such as complaints, refusals, or completed conversions. The second group is consent and the legality of communication. Banking CRM automation cannot ignore that direct marketing via email, SMS, or similar channels is subject to valid, specific, and recorded consent in many use cases. Current ICO guidance on electronic and telephone marketing stresses that consent must be knowingly and freely given, clear, specific, and supported by evidence of how and when it was obtained [8]. For this reason, the proposed tool stores channel-level consent flags, source-of-consent metadata, withdrawal states, and suppression history within the communication profile. The third group is temporal optimisation. Rather than assuming the same sending interval is effective for all clients, the system identifies the most suitable sending interval based on observed interaction rhythms, prior open and response patterns, business-hour constraints, and campaign urgency. An action that violates any of these three groups of constraints is excluded from the final queue, even if it is highly commercially attractive.

The next-best-action output is therefore a ranked set of candidate scenarios, each with a channel, a content family, a time window, and an execution priority. Product relevance is used to distinguish between scenarios that are superficially similar but commercially different. For instance, a current-account customer who has recently activated a salary project and frequently uses the mobile application may be more suitable for a credit-card limit increase or a savings recommendation than for a generic acquisition message. Conversely, a prospective lead who repeatedly uses a mortgage calculator but has not finished the application may require either a reminder, a consultation invitation, or a call-centre escalation, depending on response probability, contact limits, and current consent status. Studies on banking app experience suggest that digital support quality and ease of navigation materially shape customer satisfaction [2], while work on AI in mobile banking confirms the growing importance of trust, convenience, and perceived service quality in digital engagement [3]. The proposed model transforms these general insights into a software mechanism in which the next communication action is not predefined by a single rigid journey script but selected adaptively from a constrained set of meaningful actions.

The second part of the proposed solution concerns further developing CRM integration with the bank's communication channels. Even a strong prioritisation model will produce unstable or contradictory outputs if the surrounding data contour is inconsistent. A common practical problem is that the same person exists in the CRM in several slightly different forms: one lead card created from a website form, another from a branch enquiry, a third from an imported campaign file, and a fourth from a partner channel. If these records are not reconciled, the bank cannot reconstruct a coherent interaction history and cannot reliably enforce contact limits, consent status, or conversion ownership. Record linkage and deduplication literature shows that modern data-quality frameworks must combine normalisation, similarity matching, and reconciliation procedures rather than rely solely on exact-key matching [9]. This observation is particularly relevant to banking CRM systems, where identifiers may be incomplete during early acquisition stages and where different systems capture names, phone numbers, email addresses, and demographic attributes with varying levels of precision.

For this reason, the software tool includes a fuzzy attribute-matching-based deduplication service. Its purpose is not to merge records indiscriminately, but to detect likely identity overlap and to create a governed master communication profile. Before a message is scheduled or a contact outcome is written back into CRM, the service compares candidate records across normalised name fields, transliteration variants, phone-number patterns, e-mail similarity, date-of-birth fragments, and behavioural linkage signals such as device or session continuity. The matching result is then classified into three categories: direct merge, manual review, or keep separate. The merge decision is further constrained by risk-aware rules to prevent unsafe record unification, which could result in records belonging to different individuals being merged. In the banking context, this conservative design is important because communication history, consent evidence, and product ownership must remain auditable. The result of deduplication is a cleaner client base and, more importantly, a more coherent communication memory from which the prioritisation engine can reason.

Without this step, the same person may occupy multiple positions in the queue, with contradictory actions attached to each record.

A second integration mechanism is interaction event journaling. Instead of storing only final CRM statuses such as “sent”, “opened”, or “call completed”, the proposed software tool logs the full sequence of communication events: scenario creation, admissibility check, channel dispatch, delivery response, operator assignment, operator closure, customer click, reply, unsubscribe, complaint registration, and scenario termination. These events are recorded in chronological form and propagated through an event-driven integration layer. Industry studies on microservices and evolvability note that event-driven messaging is widely used to decouple services and enable more flexible, long-running communication between components [10]. In the banking CRM domain, this architectural choice enables synchronisation of the prioritisation engine, channel gateway, operator workplace, and analytical read model without forcing all operations into a single synchronous transaction. Scenario routing tables define which event combinations trigger which subsequent actions. For example, a delivered e-mail with no interaction within a configured period may activate a web-push reminder or a low-priority operator task, whereas a successful callback may immediately suppress all parallel promotional communications for the same product family.

The integrity of this integration layer depends on access governance and API reliability. The software tool, therefore, applies role-based access control to operational actions such as editing consent attributes, approving merges, releasing campaign scenarios, changing routing rules, or overriding contact frequency limits. This is consistent with current API security guidance, which places authorisation failures among the most critical risks in modern API-based systems [11]. In addition, the tool enforces idempotency for both external and internal API calls. In distributed communication workflows, the same request may be retried due to a timeout, lost acknowledgement, or a temporary gateway failure. HTTP semantics explicitly distinguish idempotent operations because repeated identical requests should have the same intended effect on the server as one request [12]. Building on this principle, each state-changing CRM integration request is supplied with an idempotency key and checked against the event journal before write-back. As a consequence, repeated delivery callbacks do not create duplicate contact outcomes, repeated operator submissions do not reopen closed scenarios, and repeated synchronisation attempts after transient failures do not multiply client history records. Secure development and operational hardening of these mechanisms are further aligned with the SSDF recommendations for reducing software vulnerabilities and improving traceable secure development practices [13].

From the implementation perspective, the proposed software tool has a modular web-oriented structure. The CRM integration module maintains the unified communication profile and normalised identifiers. The prioritisation module calculates candidate actions and their priority order from behavioural, predictive, and governance-related inputs. The scenario orchestrator manages message templates, routing tables, and state transitions. The event journal stores all communication events and exposes them to the reporting layer. The channel gateway adapter connects the system to e-mail, SMS, web-push, and call-centre services, while the operator interface provides controlled manual intervention for review, callback, and escalation. Such modularity ensures that banks can introduce the tool incrementally: first by consolidating client identities and event history, then by enabling next-best-action ranking for selected products, and only afterwards by expanding the full omnichannel orchestration logic. This staged deployment path is practically important because banking institutions often need to modernise legacy communication systems without replacing all surrounding systems at once.

To evaluate the proposed approach, a scenario-based experimental study of a prototype was conducted on a synthetic dataset structurally aligned with retail banking operations. The dataset contained 214,000 customer and lead records, 1.86 million interaction events from digital and operator channels, 14 banking-product categories, and historically reconstructed consent and suppression states. Controlled duplicate variations were injected into the client base to simulate heterogeneity in name spellings, incomplete contact fields, and independently created lead cards. The comparison baseline for communication decision-making was a static-rule workflow based on predefined campaign segments and fixed channel order. The comparison baseline for integration quality was an exact-match CRM synchronisation procedure without fuzzy deduplication, unified event journalling, or idempotency control. Evaluation focused on four groups of indicators: customer-base segmentation accuracy against an expert-labelled benchmark of communication cases, average response rate for released scenarios, share of duplicated client cards after reconciliation, and the proportion of synchronisation errors observed in CRM-channel write-back operations.

The experimental results confirmed the practical value of the prioritisation model. In the benchmark communication cases, the prototype improved segmentation accuracy by 19.4% relative to the static-rule baseline. This effect was produced by the joint consideration of RFM dynamics, lead maturity, predicted responsiveness, and admissibility constraints. The largest improvement was observed in borderline cases, where static rules would usually place clients into broad, generic segments, whereas the proposed model selected a narrower, more behaviourally grounded communication path. The average response rate across released scenarios increased by 16.8%, with especially noticeable gains in reminder, reactivation, and advisory callback scenarios. This suggests that the main advantage of the model lies not only in selecting "more active" clients, but in suppressing poorly timed and poorly matched contacts. The response-rate gain was therefore achieved with a more disciplined, not a more aggressive, communication policy. For banking institutions, this is important because the operational objective is not merely to send more messages, but to send fewer irrelevant messages and more contextually justified ones.

The integration-oriented results were equally significant. After applying fuzzy deduplication and governed profile reconciliation, the share of duplicated client cards decreased by 24.3% in comparison with the baseline exact-match procedure. The event journal and idempotency controls reduced synchronisation errors between the CRM and external services by 28.7%, particularly in cases of repeated delivery callbacks, delayed operator closure, and message-gateway retries. As a consequence, the communication history became more complete and internally consistent, while the number of contradictory scenario states was substantially reduced. Equally important, the operator environment benefited from the same improvements: whereas the baseline often produced parallel low-value tasks for the same person, the prototype more often showed a single consolidated customer context and a single priority action. This lowered the practical burden on staff and improved the explainability of communication decisions. Therefore, the proposed software tool demonstrated that customer prioritisation quality and integration reliability should not be treated as separate tasks; in banking CRM automation, they reinforce each other and must be engineered as part of a single communication decision contour.

Thus, the paper substantiates the development of a software tool to prioritise and select the next communication action in banking CRM systems. The proposed model of customer prioritisation combines RFM indicators, lead score, response probability, contact-frequency constraints, consent state, temporal suitability, and product relevance into a single decision mechanism that produces an ordered next-best-action queue for prospective and existing clients. The further-developed integration approach combines fuzzy deduplication of client records, interaction event journalling, role-based access control, and API idempotency control to preserve the integrity of the communication history and reduce synchronisation errors. In a scenario-based experimental evaluation of the software prototype, the solution increased segmentation accuracy by 19.4%, raised average response rate by 16.8%, reduced duplicated client cards by 24.3%, and decreased CRM-channel synchronisation errors by 28.7%. These results support the conclusion that the proposed software tool may serve as a practical technological basis for improving the relevance of communication, data coherence, and operational efficiency in contemporary banking institutions.

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