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Feasibility Model for Establishing and Implementing Smart Insurance Using a Hybrid Approach

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ABSTRACT

In the past decade, the insurance industry has been influenced by advancements in emerging technologies such as artificial intelligence (AI), blockchain, the Internet of Things (IoT), and big data analytics, leading to a shift toward digital transformation and the implementation of smart insurance practices. This study was conducted with the aim of presenting a comprehensive model for the feasibility assessment and implementation of smart insurance in Dana Insurance Company. The research employed a quantitative methodology. To develop the final model, the Delphi method was utilized. In this stage, the sample consisted of 15 insurance and academic experts. Data were collected using a questionnaire. In the subsequent phase, structural equation modeling (SEM) was applied to examine the validity of the final model. In this phase, the sample comprised 256 individuals, including managers, experts, and insurance representatives across the studied provinces. A researcher-made questionnaire was used for data collection. The validity of the questionnaire was evaluated and confirmed through construct validity, and its reliability was verified using Cronbach's alpha coefficient. The results of the SEM analysis demonstrated satisfactory construct validity of the final model. Findings from these two phases identified 12 main categories, including smart technologies and tools, information technology infrastructure, laws and regulations, organizational culture and change management, insurance processes, customer experience and services, risk assessment and claims prediction, interorganizational collaboration and interactions, data analytics and decision-making, marketing and sales, strategic implementation factors, and organizational insurance factors.

Keywords: Smart insurance, feasibility and implementation, meta-synthesis, structural equation modeling

Introduction

The insurance industry is undergoing a profound structural reconfiguration as digital technologies reshape risk discovery, pricing, distribution, claims, and even the institutional logic of intermediation. Under the umbrella of "InsurTech," incumbent carriers and new entrants are assembling stacks that combine cloud-native architectures, data-intensive analytics, automation, and platform partnerships to deliver outcomes that are faster, more transparent, and—critically—more personalized across the policy lifecycle [1-3]. While the rhetoric of transformation is now ubiquitous, empirical and design-oriented research has begun to map the concrete levers that translate technology into measurable performance in insurance enterprises—innovation capability, digital operating models, and governance arrangements that balance agility with risk and compliance [4]. Against this backdrop, a feasibility-oriented model for "smart insurance" must take seriously not only the component technologies but also their orchestration into coherent processes and institutions that deliver value to customers, ecosystems, and regulators simultaneously.

Artificial intelligence and machine learning (AI/ML) are central to this reconfiguration because they convert heterogeneous data exhaust into predictive and prescriptive signals for underwriting, claims triage, fraud detection, retention, and cross-sell. Recent syntheses show steep growth in AI/ML adoption across underwriting and claims, accompanied by new bibliometric clusters around explainability, fairness, and MLOps in insurance settings [5]. In parallel, practitioner research documents how big-data infrastructures and analytics pipelines extend the informational frontier, enabling carriers to ingest telematics, IoT device streams, geospatial imagery, and behavioral data for real-time decisioning [6]. The promise hinges on reliable data governance and model-risk management: models that are accurate in training but brittle in production can destroy value when claims volumes spike or when covariate shift undermines risk segmentation. Designing a smart insurance model therefore requires embedding AI/ML capabilities within resilient data platforms, model monitoring, and feedback loops—capabilities that our framework treats as separable but tightly coupled layers [1, 2].

A second pillar is distributed ledger technology and smart contracts, which reconfigure the contract layer itself. Concept and maturity assessments suggest that while blockchain is no panacea, there are well-defined use cases where shared, tamper-evident records and autonomous contract execution reduce reconciliation costs and accelerate claims—particularly in parametric products, reinsurance treaties, and multi-party processes [7]. Methodological work has specified how to implement blockchain-backed insurance for natural hazards, coupling oracles and event data with robust policy logic [8], while engineering studies show end-to-end solutions for parametric insurance in transport and logistics, where external data triggers automated indemnification under predefined conditions [9]. Architecture and governance remain decisive: aligning business process management (BPM) with on-chain logic clarifies roles, auditability, and exception handling [10], and cyber-insurance prototypes layering self-sovereign identity (SSI) on blockchain demonstrate privacy-preserving claims and credential flows [11]. More broadly, institutional analyses caution that enforceability, dispute resolution, and consumer protection must be designed around smart contracts to avoid shifting legal and operational risk to customers [12].

The sensorized world expands these opportunities and risks. IoT deployments in vehicles, homes, workplaces, and supply chains create continuous “evidence streams” that can price exposure dynamically, support loss prevention, and trigger automated claims; cloud–IoT reference models for integrated disaster management illustrate the operational patterns—ingest, detect, respond—needed when physical risk unfolds in real time [13]. At the same time, sector-specific models are emerging: for marine cargo, smart insurance concepts tie telemetry and workflow automation to coverage conditions [14]; for accidents, IoT-based detection and automated claim initiation have been prototyped with end-to-end paths from device to payout [15]. Smart home insurance has become a testbed for these ideas, with collaborative pricing schemes that require novel mechanism design to align insurer–insuree incentives while processing high-frequency device data [16]. Health insurance intensifies privacy, consent, and cybersecurity requirements; secure, technology-driven architectures and empirical validations demonstrate how confidentiality and integrity constraints can be embedded without blocking data-driven services [17]. Complementary security frameworks and reference designs for blockchain-based insurance emphasize authenticated data feeds, permissioning, and resilient contract upgrades as first-class design goals [18].

Digital transformation, however, is not only about components; it is an institutional process unevenly distributed across markets and lines of business. Country- and sector-level studies illustrate how policy, data infrastructure, and customer readiness shape adoption pathways. In China, post-pandemic acceleration brought remote distribution, digital claims, and ecosystem partnerships to the fore, with carriers reorganizing around platform logics and customer journeys rather than legacy product silos [19]. In rural development contexts, digital inclusive finance shows how data and mobile channels integrate primary, secondary, and tertiary industries, offering analogies for rural insurance distribution and agricultural risk pooling [20]. Conversely, research on Bangladesh documents structural bottlenecks—digital identity coverage, literacy, regulatory clarity, and distribution fragmentation—that complicate the creation of digital insurance businesses, highlighting the need for staged capability building and policy coordination [21]. These contrasts suggest that feasibility models must be sensitive to institutional baselines: the same technical pattern will have divergent costs and benefits depending on market readiness and regulatory pragmatism [1, 2].

Climate and catastrophe risk sharpen the value proposition for automation and parametrics. Theories and evidence on climate-smart insurance indicate that timely payouts and risk-reduction incentives strengthen household and firm adaptive capacity, but only when contract design and distribution are tuned to local realities [22]. Multidisciplinary implementations for natural hazards show how event detection, oracle governance, and index calibration can make parametric contracts credible and scalable [8]. Ethical scrutiny is essential: smart information systems in insurance raise questions of opacity, surveillance, and fairness in pricing and claims decisioning; case studies urge proactive ethical governance and stakeholder engagement rather than retrofit controls after deployment [23]. Even product innovation trajectories—such as "smart product insurance," where coverage is embedded into connected devices—must anticipate consent management, dark patterns in app interfaces, and distributional impacts of risk-based pricing [24]. A feasibility model that centers organizational culture, change management, and stakeholder trust is therefore not a "soft" add-on but a core mitigant against technological and reputational risk [2, 3].

Market structure and ecosystem coordination further condition outcomes. Studies of insurer–tech collaboration highlight operating models in which incumbents open APIs, curate data marketplaces, and co-innovate with startups on narrowly scoped use cases before scaling [1]. In logistics and cargo, smart contracts knit together shippers, carriers, and insurers around verifiable milestones; empirical and engineering evidence shows both feasibility and the need for standardized data schemas and dispute pathways [9, 14]. In cyber insurance, architectures that combine on-chain credentials with off-chain analytics illustrate a path to lower friction and higher assurance across underwriting and claims [11]. More generally, redefining insurance through technology requires strategy choices about "where to play" (e.g., embedded distribution vs. stand-alone channels) and "how to win" (e.g., distinctive data assets, speed of model iteration, or experience-led service design) [2]. Bibliometric and synthesis work confirms that firms that link AI/ML capability building with process redesign and talent development realize more of the theoretical gains than those that layer models on unchanged workflows [4-6].

From a governance standpoint, the feasibility of "smart" models rests on codifying rules and responsibilities at the contract, process, and organizational levels. Business-process–aware smart contract frameworks align policy wording, underwriting authorities, claims adjudication, and audit requirements with programmable logic to reduce ambiguity and operational risk [10]. InChain-style architectures and secured insurance frameworks add identity, access control, and cryptographic assurances to the mix [11, 18]. IoT-heavy configurations, particularly in property and catastrophe domains, depend on resilient cloud backbones and well-specified incident response, as demonstrated in integrated disaster management patterns [13]. Because customers experience the service layer most directly, collaborative pricing and incentive design in smart home insurance show how insurers can co-produce risk reduction with policyholders, though not without addressing equity and behavioral responses [16]. Institutional commentary suggests regulators will increasingly scrutinize smart contracts' consumer outcomes, mandating explainability, recourse mechanisms, and defaults that protect vulnerable groups [12].

Strategic alignment with sustainability adds a further axis of feasibility. Green human resource management and green supply chain practices have been empirically linked to sustainable performance, implying that smart insurance programs should not only digitize but also "green" their operations and partner networks [25]. This resonates with environmental-risk products, where index-based or usage-based coverage aligns financial incentives with mitigation behaviors [8, 22]. At the same time, industrial and regional development agendas will push insurers to support digital inclusion—rural distribution, MSME enablement, and interoperable payment rails—consistent with evidence from inclusive finance contexts [20]. Taken together, these strands suggest that the feasibility of smart insurance is path-dependent: it emerges from reinforcing loops between technology maturity, process redesign, workforce skills, ecosystem standards, and public policy [1-3].

Finally, feasibility is an empirical question about fit: which capabilities, in what sequence, for which lines and segments? Research on the technology innovation level of insurance firms indicates that leadership commitment, cross-functional data teams, and investment in reusable platforms are strong predictors of InsurTech performance, but effects vary by market and by the orientation of partners and distributors [4, 19]. Case-led contributions across domains—parametric logistics, cyber identity, marine cargo, health, home, and disaster management—accumulate into a design space where smart contracts, AI/ML, IoT, and cloud are not buzzwords but configurable building blocks [9, 11, 13, 14, 16, 17]. Early conceptualizations of smart product insurance foreshadowed this embedded, data-rich future [24], and institutional analyses now chart the guardrails required to scale without eroding trust [7, 12, 23]. Building on this literature, the present study proposes and tests a comprehensive, multi-dimensional model that integrates technological, organizational, regulatory, market, and sustainability factors to assess and guide the establishment and implementation of smart insurance in practice.

Methodology

This study is applied, survey-based, and quantitative in nature. In the operational stage, in order to refine and complete the final model, the Delphi method was employed, drawing on the opinions of experts. The experts in this phase included senior managers and insurance specialists in Sistan and Baluchestan and South Khorasan provinces. The sampling method in this stage was convenience sampling.

In the final stage, to conduct the ultimate feasibility assessment and confirm the final model, the statistical population consisted of experts, managers, and insurance representatives across the two provinces. The sampling method for this stage was cluster sampling, and the sample size was determined using Morgan's table. The sample size in the Delphi stage was 15 participants, and in the structural equation modeling (SEM) stage it was set at 256 participants.

For the initial evaluation, both open-ended and closed-ended Delphi questionnaires were used. In this phase, validity was assessed through content validity, and reliability was calculated using Cronbach's alpha coefficient at a level of 0.72. The SEM questionnaire was researcher-developed based on the results of the Delphi stage, and its specifications, validity, and reliability are presented in the following table:

Table 1

Specifications of the Research Questionnaire

Instrument Name	Number of Questions	Cronbach's Alpha	CVR Value	RMSEA Value	Validity & Reliability Confirmation
Researcher-developed questionnaire	70	0.82	0.74	0.023	Confirmed

Findings and Results

After the first round of the Delphi process, the cut-off threshold for eliminating indicators — calculated as the mean of the means of all indicators — was determined to be 3.77. Indicators scoring below this threshold were excluded. The obtained results are presented in the following table.

During this stage, the experts introduced several new components, which were also frequently mentioned among the panel:

- Infrastructural feasibility of using blockchain
- Scalability of cloud infrastructures for insurance data processing
- Infrastructure for developing image recognition and video processing tools for damage assessment
- Defining accountability standards for AI algorithms in insurance decision-making
- Incentive policies for digital innovations in the insurance industry
- Culture of continuous learning and digital skill enhancement
- Organizational leaders aware of emerging technologies
- Smart contracts for claims payment
- Capabilities of insurance applications
- Possibility of personalization in insurance services
- Use of satellite images and environmental data for geographic risk assessment
- Shared digital ecosystems between insurers and banks
- Collaboration with universities and research centers for innovation in smart insurance
- Establishment of real-time analytics structures
- Implementation of insurance recommendation systems
- Definition of a technology roadmap for smart insurance
- Internal transparency and data sharing across departments

Table 2

Results from the First Round of Delphi

No.	Indicator	Frequency	Mean	Standard Deviation
1	Use of artificial intelligence in data processing	15	3.77	0.0276
2	Insurance simulation and modeling systems	15	3.78	0.0347
3	Internet of Things and integration with insurance systems	15	3.78	0.0347
4	Data mining and predictive analytics in insurance	15	3.78	0.0347
5	Technology-oriented and data-driven culture	15	3.78	0.0347
6	Required software and hardware	15	3.78	0.0347
7	Information security and data protection	15	3.78	0.0347
8	Development and enhancement of insurance software and hardware	15	3.87	0.0983
9	Technical requirements and capabilities in insurance	15	3.78	0.0347
10	Artificial intelligence infrastructures	15	3.86	0.0913
11	Level of interaction and social network infrastructure	15	3.74	0.0064
12	Data mining infrastructures	15	3.77	0.0276
13	Communication infrastructure between software systems	15	3.77	0.0276
14	New regulations in the field of smart insurance	15	3.80	0.0488

15	Compliance with international and national standards	15	3.69	0.0983
16	Data privacy and related regulations	15	3.77	0.0276
17	Legal processes in adopting smart insurance	15	3.87	0.0983
18	Acceptance and change of organizational culture	15	3.80	0.0488
19	Training in artificial intelligence and emerging technologies	15	3.80	0.0488
20	Cultural resistance and challenges	15	3.78	0.0347
21	Organizational change management	15	3.77	0.0276
22	Automation of insurance processes	15	3.80	0.0488
23	Designing intelligent processes for risk assessment and pricing	15	3.74	1.9311
24	Process optimization using data analytics	15	3.87	0.0983
25	Provision of fast and smart insurance services	2	3.78	0.0347
26	Improving interactions with chatbots and smart assistants	3	3.87	0.0983
27	Customer awareness and acceptance	15	3.87	0.0983
28	Customer feedback analysis for service improvement	15	3.87	0.0983
29	Use of predictive models in risk assessment	15	3.77	0.0276
30	Damage data analysis for simulation	15	3.77	0.0276
31	Risk assessment with machine learning	15	3.78	0.0007
32	Damage prediction using big data analytics	15	3.74	0.0064
33	Collaboration with insurance companies and startups	15	3.73	0.0007
34	Collaboration with governmental and private institutions	15	3.65	0.0488
35	Use of big data in decision-making	15	3.74	0.0064
36	Development of machine learning algorithms	15	3.88	0.1054
37	Data analytics to detect hidden patterns	15	3.74	0.0064
38	Use of digital advertising in insurance marketing	15	3.80	0.0488
39	Improving sales strategies using smart data	15	3.80	0.0488
40	Designing advertising programs using intelligent algorithms	15	3.80	0.0488
41	Simulation of insurance market needs using predictive models	15	3.80	0.0488
42	Required financial resources	15	3.80	0.0488
43	Skilled human resources ready for adoption	15	3.80	0.0488
44	Stakeholder acceptance and readiness	15	3.78	0.0347
45	Support and management	15	3.78	0.0347
46	Organizational integration and alignment	15	3.78	0.0347
47	Agility of insurance processes	15	3.78	0.0347
48	Flexible organizational structure	15	3.78	0.0347
49	Awareness level of managers and employees	15	3.77	0.0276
50	Process intelligence implementation	15	3.77	0.0276
51	Adaptation of insurance agencies	15	3.78	0.5246

In this stage, the questionnaire — after removing indicators that scored below the cut-off threshold and incorporating indicators that were added, modified, or adapted based on expert opinion and aligned with the intended subcategories — was resent to the expert panel members. The responses collected in this round were analyzed in the same manner as in the first round, and the results are presented in the following table.

Table 3

Results from the Second Round of Delphi

No.	Indicator	Frequency	Mean	Standard Deviation
1	Use of artificial intelligence in data processing	15	3.90	0.119535
2	Insurance simulation and modeling systems	15	3.82	0.062966
3	Internet of Things and integration with insurance systems	15	3.88	0.105393
4	Data mining and predictive analytics in insurance	15	3.90	0.119535
5	Technology-oriented and data-driven culture	15	3.90	0.119535
6	Required software and hardware	15	3.88	0.105393
7	Infrastructural feasibility of using blockchain	15	3.88	0.105393
8	Information security and data protection	15	3.88	0.105393
9	Development and enhancement of insurance software and hardware	15	3.86	0.09125
10	Technical requirements and capabilities in insurance	15	3.84	0.077108
11	Availability of local data centers with advanced security standards	15	3.87	0.098322
12	Artificial intelligence infrastructures	15	3.87	0.098322
13	Scalability of cloud infrastructures for insurance data processing	15	3.82	0.062966
14	Level of interaction and social network infrastructure	15	3.87	0.098322

15	Infrastructure for developing image recognition and video processing tools for damage assessment	15	3.82	0.062966
16	Data mining infrastructures	15	3.82	0.062966
17	Communication infrastructure between software systems	15	3.88	0.105393
18	New regulations in the field of smart insurance	15	3.87	0.098322
19	Defining accountability standards for AI algorithms in insurance decision-making	15	3.82	0.062966
20	Compliance with international and national standards	15	3.87	0.098322
21	Incentive policies for digital innovations in the insurance industry	15	3.87	0.098322
22	Data privacy and related regulations	15	3.88	0.105393
23	Legal processes in adopting smart insurance	15	3.87	0.098322
24	Acceptance and change of organizational culture	15	3.87	0.098322
25	Training in artificial intelligence and emerging technologies	15	3.87	0.098322
26	Culture of continuous learning and digital skill enhancement	15	3.88	0.105393
27	Cultural resistance and challenges	15	3.88	0.105393
28	Organizational leaders aware of emerging technologies	15	3.88	0.105393
29	Organizational change management	15	3.88	0.105393
30	Automation of insurance processes	15	3.83	0.070037
31	Designing intelligent processes for risk assessment and pricing	15	3.82	0.062966
32	Process optimization using data analytics	15	3.88	0.105393
33	Smart contracts for claims payment	15	3.84	0.077108
34	Workflow management systems	15	3.82	0.062966
35	Provision of fast and smart insurance services	15	3.82	0.062966
36	Capabilities of insurance applications	15	3.85	0.084179
37	Improving interactions with chatbots and smart assistants	15	3.87	0.098322
38	Possibility of personalization in insurance services	15	3.86	0.09125
39	Customer awareness and acceptance	15	3.87	0.098322
40	Customer feedback analysis for service improvement	15	3.85	0.084179
41	Use of predictive models in risk assessment	15	3.90	0.119535
42	Damage data analysis for simulation	15	3.82	0.062966
43	Risk assessment with machine learning	15	3.88	0.105393
44	Use of satellite images and environmental data for geographic risk assessment	15	3.90	0.119535
45	Damage prediction using big data analytics	15	3.90	0.119535
46	Collaboration with insurance companies and startups	15	3.88	0.105393
47	Collaboration with governmental and private institutions	15	3.88	0.105393
48	Shared digital ecosystems between insurers and banks	15	3.88	0.105393
49	Collaboration with universities and research centers for innovation in smart insurance	15	3.86	0.09125
50	Use of big data in decision-making	15	3.84	0.077108
51	Development of machine learning algorithms	15	3.87	0.098322
52	Establishment of real-time analytics structures	15	3.87	0.098322
53	Data analytics to detect hidden patterns	15	3.82	0.062966
54	Use of digital advertising in insurance marketing	15	3.87	0.098322
55	Improving sales strategies using smart data	15	3.87	0.098322
56	Designing advertising programs using intelligent algorithms	15	3.82	0.062966
57	Simulation of insurance market needs using predictive models	15	3.82	0.062966
58	Implementation of insurance recommendation systems	15	3.88	0.105393
59	Required financial resources	15	3.87	0.098322
60	Definition of a technology roadmap for smart insurance	15	3.82	0.062966
61	Skilled human resources ready for adoption	15	3.96	0.062966
62	Stakeholder acceptance and readiness	15	3.82	0.586585
63	Support and management	15	3.93	0.105393
64	Organizational integration and alignment	15	3.87	0.958652
65	Agility of insurance processes	15	3.82	0.458658
66	Flexible organizational structure	15	3.95	0.098322
67	Awareness level of managers and employees	15	3.90	0.119535
68	Process intelligence implementation	15	3.82	0.062966
69	Adaptation of insurance agencies	15	3.88	0.105393
70	Internal transparency and data sharing across departments	15	3.87	0.105393

In this stage, the questionnaire—along with each individual's prior score and the extent of its deviation from the views of other experts—was resent to the expert panel, and the members responded to the items considering the perspectives of other panelists. The results are presented in the table below. Based on the views expressed in the second round and their comparison with the results of the third round, if the difference between the two rounds is less than the cut-off threshold (completely insignificant = 1), the survey is stopped.

Table 3

Results from the Third Round of Delphi

No.	Indicator	Frequency	Mean (Round 2)	Mean (Round 3)	Difference (Rounds 2–3)
1	Use of artificial intelligence in data processing	15	3.90	3.99	0.09
2	Insurance simulation and modeling systems	15	3.82	3.88	0.06
3	Internet of Things and integration with insurance systems	15	3.88	4.00	0.12
4	Data mining and predictive analytics in insurance	15	3.90	3.90	0.00
5	Technology-oriented and data-driven culture	15	3.90	3.90	0.00
6	Required software and hardware	15	3.88	3.88	0.00
7	Infrastructural feasibility of using blockchain	15	3.88	3.88	0.00
8	Information security and data protection	15	3.88	3.88	0.00
9	Development and enhancement of insurance software and hardware	15	3.86	3.89	0.03
10	Technical requirements and capabilities in insurance	15	3.84	3.84	0.00
11	Availability of local data centers (Data Center) with advanced security standards	15	3.87	3.87	0.00
12	Artificial intelligence infrastructures	15	3.87	3.87	0.00
13	Scalability of cloud infrastructures for insurance data processing	15	3.82	3.82	0.00
14	Level of interaction and social network infrastructure	15	3.87	3.87	0.00
15	Infrastructure for developing image recognition and video processing tools for damage assessment	15	3.82	3.82	0.00
16	Data mining infrastructures	15	3.82	3.82	0.00
17	Communication infrastructure between software systems	15	3.88	3.88	0.00
18	New regulations in the field of smart insurance	15	3.87	3.97	0.10
19	Defining accountability standards for AI algorithms in insurance decision-making	15	3.82	3.82	0.00
20	Compliance with international and national standards	15	3.87	3.87	0.00
21	Incentive policies for digital innovations in the insurance industry	15	3.87	3.87	0.00
22	Data privacy and related regulations	15	3.88	3.88	0.00
23	Legal processes in adopting smart insurance	15	3.87	3.97	0.10
24	Acceptance and change of organizational culture	15	3.87	3.87	0.00
25	Training in artificial intelligence and emerging technologies	15	3.87	3.87	0.00
26	Culture of continuous learning and digital skill enhancement	15	3.88	3.88	0.00
27	Cultural resistance and challenges	15	3.88	3.88	0.00
28	Organizational leaders aware of emerging technologies	15	3.88	3.88	0.00
29	Organizational change management	15	3.88	3.88	0.00
30	Automation of insurance processes	15	3.83	3.83	0.00
31	Designing intelligent processes for risk assessment and pricing	15	3.82	3.82	0.00
32	Process optimization using data analytics	15	3.88	3.88	0.00
33	Smart contracts for claims payment	15	3.84	3.84	0.00
34	Workflow management systems	15	3.82	3.82	0.00
35	Provision of fast and smart insurance services	15	3.82	3.82	0.00
36	Capabilities of insurance applications	15	3.85	3.85	0.00
37	Improving interactions with chatbots and smart assistants	15	3.87	3.88	0.01
38	Possibility of personalization in insurance services	15	3.86	3.86	0.00
39	Customer awareness and acceptance	15	3.87	3.87	0.00
40	Customer feedback analysis for service improvement	15	3.85	3.87	0.02
41	Use of predictive models in risk assessment	15	3.90	3.99	0.09
42	Damage data analysis for simulation	15	3.82	3.88	0.06
43	Risk assessment with machine learning	15	3.88	3.92	0.04
44	Use of satellite images and environmental data for geographic risk assessment	15	3.90	3.99	0.09
45	Damage prediction using big data analytics	15	3.90	3.98	0.08
46	Collaboration with insurance companies and startups	15	3.88	3.90	0.02
47	Collaboration with governmental and private institutions	15	3.88	3.91	0.03
48	Shared digital ecosystems between insurers and banks	15	3.88	3.92	0.04
49	Collaboration with universities and research centers for innovation in smart insurance	15	3.86	3.88	0.02
50	Use of big data in decision-making	15	3.84	3.88	0.04
51	Development of machine learning algorithms	15	3.87	3.91	0.04
52	Establishment of real-time analytics structures	15	3.87	3.90	0.03

53	Data analytics to detect hidden patterns	15	3.82	3.91	0.09
54	Use of digital advertising in insurance marketing	15	3.87	3.89	0.02
55	Improving sales strategies using smart data	15	3.87	3.88	0.01
56	Designing advertising programs using intelligent algorithms	15	3.82	3.89	0.07
57	Simulation of insurance market needs using predictive models	15	3.82	3.91	0.09
58	Implementation of insurance recommendation systems	15	3.88	3.89	0.01
59	Required financial resources	15	3.87	3.97	0.10
60	Definition of a technology roadmap (Roadmap) for smart insurance	15	3.82	3.91	0.09
61	Skilled human resources ready for adoption	15	3.96	3.99	0.03
62	Stakeholder acceptance and readiness	15	3.82	3.83	0.01
63	Support and management	15	3.93	3.90	-0.03
64	Organizational integration and alignment	15	3.87	3.91	0.04
65	Agility of insurance processes	15	3.82	3.92	0.10
66	Flexible organizational structure	15	3.95	3.88	-0.07
67	Awareness level of managers and employees	15	3.90	3.88	-0.02
68	Process intelligence implementation	15	3.82	3.91	0.09
69	Adaptation of insurance agencies	15	3.88	3.89	0.02
70	Internal transparency and data sharing across departments	15	3.87	3.88	0.01

As the table above shows, the expert panel reached consensus on all components, and the level of disagreement between the second and third rounds was far below the cut-off threshold; therefore, the survey was terminated, and the final output obtained from this stage is as presented in the table above.

In this section, to assess the model fit, the final extracted model from the previous stage was evaluated using first-order and second-order confirmatory factor analysis (CFA). The results of the final model fit are presented in the following figure and tables. Additionally, the opinions of 256 managers, experts, and insurance representatives from the studied provinces were utilized. First, the demographic characteristics of these participants are examined:

Table 5

Demographic Characteristics of the Research Sample

Variable	Group	Frequency (n)	Percentage (%)
Gender	Female	110	43
	Male	146	57
Education	Below Bachelor’s	40	15.6
	Bachelor’s	110	43
	Master’s	90	35.2
	Doctorate	16	6.2
Work Experience	Less than 5 years	70	27.3
	6–10 years	80	31.3
	11–15 years	60	23.4
	Over 16 years	46	18

In the gender distribution, the results show that the majority of respondents are male, accounting for 57% of the total sample, while females constitute 43%. This indicates higher male participation in the survey, which may be a consideration when analyzing the research findings.

Regarding education level, most respondents hold a Bachelor’s degree (43%), followed by those with a Master’s degree (35.2%). The proportion of respondents with a Doctorate is relatively small at 6.2%, while 15.6% have education below the Bachelor’s level. This distribution indicates that most participants have a university education, with a strong representation at the undergraduate level.

In terms of work experience, the highest proportion belongs to participants with 6–10 years of experience (31.3%), followed by those with less than 5 years (27.3%). Respondents with 11–15 years of experience account for 23.4%, and those with more than 16 years make up 18%. This suggests that the sample is composed primarily of individuals with moderate work experience, though it includes both less and highly experienced participants.

The following section describes the descriptive status of the main identified categories:

Table 6

Descriptive Statistics of Research Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
Smart technologies and tools	2.12	2.99	2.539	0.24682
IT infrastructure and resources	2.12	2.99	2.553	0.25055
Laws and regulations	2.12	2.99	2.560	0.25498
Organizational culture and change	3.02	4.12	3.587	0.31556
Insurance processes	2.12	2.99	2.554	0.24767
Customer experience and services	2.12	2.99	2.549	0.25142
Risk assessment and claims prediction	2.12	2.99	2.539	0.24103
Interorganizational collaboration and interactions	3.02	4.12	3.579	0.32868
Data analytics and decision-making	2.12	2.99	2.547	0.24781
Marketing and sales	2.12	2.99	2.557	0.25102
Strategic implementation factors	3.01	4.12	3.557	0.32140
Organizational factors	2.12	2.99	2.530	0.26040

Based on the descriptive data, the highest means belong to the variables “Organizational culture and change” (3.587) and “Interorganizational collaboration and interactions” (3.579), indicating the high importance of these factors in the feasibility and implementation of smart insurance from the respondents’ perspective. “Strategic implementation factors” (3.557) follows closely. Conversely, variables such as “Smart technologies and tools” (2.539) and “Risk assessment and claims prediction” (2.539) have the lowest means, suggesting that technological aspects may be perceived as less critical compared to human, strategic, and cultural dimensions in this context. Overall, the mean scores emphasize that human, strategic, and cultural factors are considered more central to smart insurance implementation than technological infrastructure.

In this stage, the extracted model fit was analyzed and reported using the AMOS software environment:

Table 7

Final Model Fit Indices

Index	Obtained Value	Acceptable Value	Status
CMIN/df	1.331	< 3	Accepted
RMSEA	0.037	RMSEA < 0.08	Accepted

According to the table above, all indices examined to evaluate the confirmatory factor analysis (CFA) model fit were within the acceptable range. Therefore, the model fit is confirmed.

Additionally, the composite reliability (CR) and average variance extracted (AVE) of the latent variables are presented below:

Table 8

Composite Reliability and Average Variance Extracted of Latent Variables

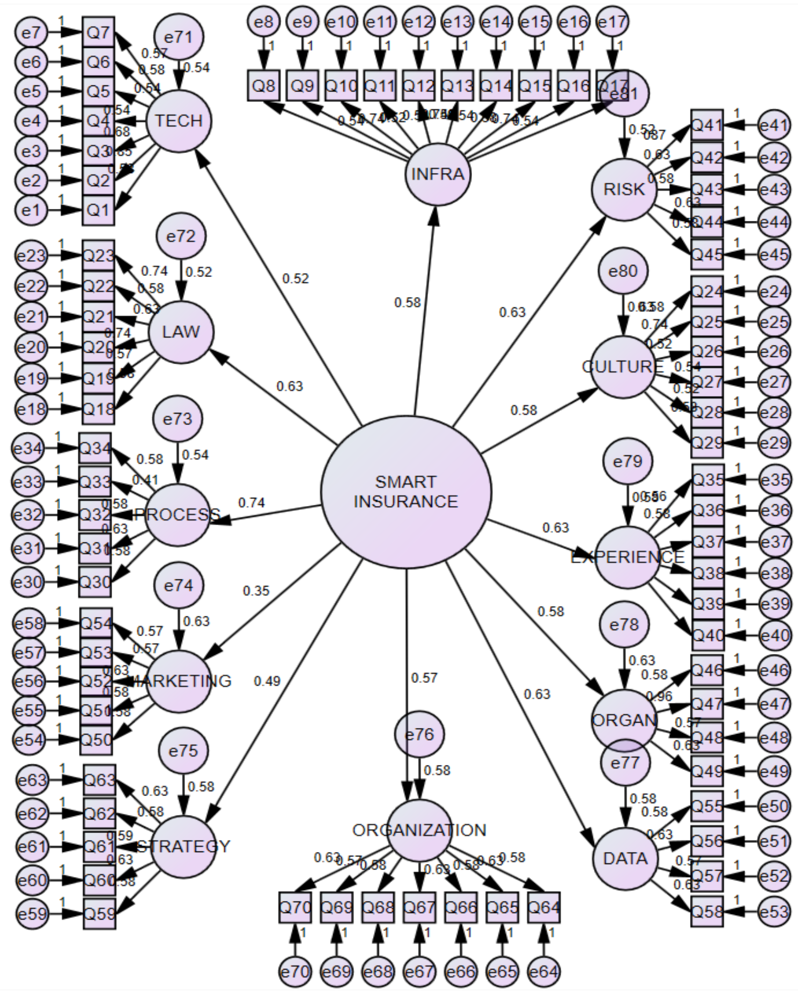
Latent Variable	CR	AVE
Smart technologies and tools	0.79	0.75
IT infrastructure and resources	0.94	0.63
Laws and regulations	0.88	0.62
Organizational culture and change	0.85	0.67

Insurance processes	0.74	0.65
Customer experience and services	0.74	0.66
Risk assessment and claims prediction	0.71	0.63
Interorganizational collaboration and interactions	0.92	0.75
Data analytics and decision-making	0.85	0.68
Marketing and sales	0.88	0.69
Strategic implementation factors	0.71	0.65
Organizational factors	0.94	0.61

Based on the results, all latent variables have CR values greater than 0.7, indicating adequate composite reliability and strong measurement tool consistency. Additionally, all AVE values exceed 0.5, confirming good convergent validity. Among these, "IT infrastructure and resources" and "Organizational factors" have the highest CR values (0.94), while "Risk assessment and claims prediction" records the lowest CR (0.71). In terms of AVE, "Smart technologies and tools" and "Interorganizational collaboration and interactions" achieve the highest value (0.75), while "Organizational factors" show the lowest (0.61). Overall, these results indicate satisfactory measurement quality and robust construct validity in evaluating the dimensions of smart insurance.

Figure 1

Structural Model of Smart Insurance



Discussion and Conclusion

The results of this study confirm that the proposed multi-dimensional feasibility model for establishing and implementing smart insurance is both theoretically robust and empirically valid. Through three Delphi rounds with insurance and academic experts, 12 core categories were identified and refined, and confirmatory factor analysis validated their structural fit. Notably, “organizational culture and change,” “interorganizational collaboration and interactions,” and “strategic implementation factors” emerged with higher mean scores, while purely technological elements such as “smart technologies and tools” and “risk assessment and claims prediction” were rated lower. This distribution provides a nuanced view of how the insurance ecosystem perceives the transition toward smart insurance.

These findings align with the growing literature indicating that digital transformation in insurance is not solely a technological challenge but a deep organizational and strategic one. Previous research shows that cultural readiness, leadership commitment, and process redesign are pivotal to translating technical potential into measurable impact [1-3]. The relatively higher emphasis on culture and strategy in our results echoes the argument that technology-driven disruption requires not only infrastructure but also new organizational mindsets and capability frameworks [4]. This supports the claim that InsurTech adoption cannot be reduced to isolated digital initiatives; it must be embedded in enterprise-wide transformation programs where human and strategic enablers are prioritized.

Our results also highlight the essential role of ecosystem collaboration. The category “interorganizational collaboration and interactions” scored among the highest, underscoring that smart insurance depends on multi-party coordination. Prior studies have shown how blockchain-based parametric insurance for transport and logistics relies on well-defined cross-party data flows and governance [9]. Similarly, cyber insurance frameworks using blockchain and self-sovereign identity illustrate that distributed architectures succeed when insurers, technology providers, and regulators co-design standards [11]. These findings support the argument that collaboration platforms and shared digital ecosystems between insurers, banks, and insurtech startups are prerequisites for scaling innovations [10, 14]. Without such coordination, interoperability gaps and regulatory uncertainty can block adoption [12].

Interestingly, while AI and IoT capabilities were acknowledged, they were not rated as highly as organizational or collaborative factors. This may reflect a pragmatic industry view: although AI/ML and IoT are powerful, their success depends on reliable data governance, model validation, and integration into workflows [5, 6]. Earlier evidence has shown that AI and machine learning promise improvements in underwriting and claims but also raise issues of explainability, fairness, and operational brittleness when not matched by organizational oversight [1, 2]. Similarly, IoT-based accident detection and smart home insurance systems demonstrate clear benefits but introduce new complexity in privacy and cybersecurity [15-17]. The lower scores for pure technology categories may therefore signal that respondents perceive these tools as enablers rather than success determinants by themselves.

Another important alignment is with the body of research on blockchain and smart contracts. Although our respondents considered blockchain infrastructure and smart contracts important, their ratings were moderate, possibly indicating cautious optimism. The literature is clear that blockchain maturity for insurance is advancing but still faces governance and scalability hurdles [7, 8]. Methodological frameworks emphasize the need to integrate blockchain with business process management to address exception handling and compliance [10], and secure designs like INCHAIN aim to overcome privacy and identity issues [11, 18]. Our findings reinforce these insights: technology is promising but must be complemented by clear standards and regulatory adaptation.

The confirmed importance of customer-centric dimensions such as “customer experience and services” and “marketing and sales” also fits with the service innovation perspective in insurance. Embedded and “smart product” insurance models emphasize user experience, personalization, and frictionless claims as differentiators [3, 24]. Studies on digital advertising, data-driven sales strategies, and IoT-enabled engagement suggest that digital front-ends and predictive personalization can increase adoption and retention [6, 16]. Our respondents’ inclusion of variables like chatbots, recommendation systems, and fast digital claims underscores the market pull for convenient, transparent customer interactions.

Sustainability and resilience themes indirectly surfaced as well. The strategic category included financial resource planning and long-term capability development, echoing research that ties digital insurance transformation to sustainable performance [25]. Climate-smart insurance studies show that rapid, index-based payouts and risk-reduction incentives can enhance resilience but require trust and tailored contract design [22]. Our model’s recognition of environmental data, satellite imagery, and geographic risk assessment aligns with this evidence and signals an appetite for integrating sustainability and risk adaptation into smart insurance roadmaps.

The statistical validation using confirmatory factor analysis strengthens these interpretive connections. All latent variables demonstrated high composite reliability and acceptable convergent validity, particularly in the organizational and IT infrastructure dimensions. This matches bibliometric findings that digital capability maturity and platformization correlate with success in InsurTech deployments [1, 4]. The robustness of cultural and strategic constructs is also consistent with frameworks proposing staged digital transformation, where soft factors like leadership and readiness precede full-scale technological embedding [2, 3]. The lower but adequate reliability for risk prediction dimensions may suggest evolving practices, consistent with ongoing debates about explainable AI and trusted predictive analytics in insurance [5, 6].

Overall, the findings converge with and extend the existing InsurTech and smart insurance literature. They affirm that a feasibility model must integrate both “hard” technology layers and “soft” organizational, market, and regulatory layers. They also show that in emerging and developing contexts, cultural readiness and ecosystem collaboration may outweigh the mere availability of advanced tools. This integrative insight helps refine theoretical models of digital insurance transformation and provides a practical roadmap for industry players.

This study is cross-sectional and reflects the perspectives of experts and practitioners from specific geographic and market contexts, primarily two provinces with their own regulatory and infrastructural conditions. Although Delphi and structural equation modeling provide strong methodological rigor, the results cannot be assumed to generalize to all insurance ecosystems, especially those with different maturity levels or policy environments. The reliance on self-reported perceptions introduces potential response bias, and the use of purposive sampling may underrepresent dissenting or minority views. Furthermore, the technology landscape evolves rapidly; what was feasible and strategically salient at the time of data collection may shift as AI, IoT, and blockchain mature or as regulations adapt.

Future studies could adopt longitudinal designs to observe how the identified factors evolve over time as insurers move from pilot initiatives to scaled smart insurance models. Comparative cross-country research would help refine the model by incorporating regulatory diversity, cultural variance, and market readiness differences. Quantitative impact studies could test how specific enablers—such as data governance frameworks, ecosystem partnerships, or customer experience innovations—

directly influence key performance outcomes like loss ratios, fraud reduction, or customer retention. Integration with emerging domains such as ethical AI, cybersecurity assurance, and sustainability-linked insurance products could further enrich the model and ensure it remains relevant in rapidly changing technological and environmental contexts.

Insurance organizations seeking to implement smart insurance should view technology as a strategic enabler rather than an end in itself. Prioritizing cultural readiness, leadership alignment, and cross-department collaboration can accelerate adoption and reduce resistance. Building partnerships with technology providers, regulators, and academic institutions can mitigate interoperability and compliance risks while expanding innovation capacity. Customer-centric digital touchpoints, secure data architectures, and explainable AI models will strengthen trust and differentiation. Finally, embedding sustainability considerations and long-term capability building into smart insurance strategies can create resilience and competitive advantage as the market and regulatory landscapes continue to evolve.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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