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Automation of Reporting System Using Visual Basic for Application Macro: A Case Study in an Insurance Company

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Abstract

Insurance companies struggle with regards to managing data entry due to their over-reliance on the manual handling of such activities by their internal staff. This has become even more pronounced as these companies are implementing digital transformation initiatives. This paper describes several practical methods for automating the many business processes of insurance companies using Visual Basic for Applications (VBA) tools that have been developed in Excel. Waterfall methodology, which is a linear process to define the requirements pre-system development, was followed by the Development and Testing phases, leading to Deployment. The implementation of five VBA tools assisted in the generation of Medical Benefit Reports (MBR) and daily claims reports for both individual and group claims, as well as the automation of documentation for Payments and First Payment Proposals (FPPs). The functional and usability testing and performance evaluation phases of the system demonstrated that the processing time was reduced between 70.00% and 91.67% with the benefits of increased consistency and improved user experience. The research findings show that VBA-based automation serves as an affordable solution that enables insurance companies to improve their operational processes through automation in environments where system integration options remain restricted.

Keywords
Insurance operations; Process automation; Visual Basic for Applications (VBA); Claims management; Operational efficiency

1. Introduction
Insurance functions as an economic development tool, which banks and capital markets do because insurance provides organized systems to move risks between people and businesses, and government agencies (Čabarkapa et al. 2022). The G-20 economic data shows that insurance sector expansion leads to economic growth, while economic growth leads to insurance sector development, which makes insurance a two-way relationship as both an economic growth driver and an economic growth receiver (Tasdemir and Alsu 2024). The insurance industry enables sustainable economic growth through its ability to activate stored funds from long-term savings and create financial system strength and direct capital toward building infrastructure and productive asset development (Panchal and Rao 2024; Dilek and Meral 2025). Insurance companies serve as leading institutional investors who support capital markets by investing in both public and private funding through their debt and equity acquisition activities (van der Heide and Kohl 2024; Knox and Sørensen 2024). The introduction of new technology has resulted in changes to the organization of their data and their processes. As a result, this will have a positive impact on the economy by improving its structure (Ajide et al. 2023; Upadhyaya et al. 2024). In contrast, with the rise of insurance premiums, combined with the lack of efficiency within these companies, it will not only have an impact on the economy as a whole but will also continue to negatively affect it (Ajide et al. 2023; Upadhyaya et al. 2024).

An ever-growing competitive and regulatory environment, coupled with ever-increasing consumer expectations, leads to insurers needing to develop better operational processes and enhanced capabilities for their clients. The digital era has made organizations dependent on manual work and paper-based operations, which no longer function properly, so they need to automate their systems and transform their operations into digital systems. The field of research has established various factors that lead to this transformation. The insurance sector faces three main external challenges, which include market competition and regulatory requirements, and customers who demand fast service with clear and correct information (Schwarzbach et al. 2023). Organizations need to fight their natural resistance to change because they operate with outdated information systems and their staff lacks the necessary skills, and their organizational culture opposes transformation when they work on expanding their digital abilities and leadership skills (Zhang et al. 2023; Sestino et al. 2025). Legacy information systems store their data through exclusive formats that remain separated in independent storage units, which block modern analytics and artificial intelligence platforms from accessing this information (Singh 2025).

Digital transformation requires businesses to adopt more than basic digital conversion and robotic process automation systems. The available proof shows that organizations must have all their elements prepared for transformation to succeed, which includes their technology systems and their process structures and their leadership abilities and their staff expertise, and their organizational values (Michelotto and Joia 2024). Lightweight flexible automation solutions maintain their importance in settings that have financial constraints and restricted human resources, and limited system compatibility.

This research aims to create and deploy an Excel VBA solution that will automate insurance business operations. The scope is defined along three dimensions. The research concentrates on insurance operations because this industry selection enables the analysis to focus on commercial areas. The study focuses on design and implementation activities instead of post-implementation maintenance because it wants to develop applicable solutions. All empirical data for this research stems from direct insurance firm participation, which enables contextual validity. This study investigates VBA benefits for insurance operations through its explanation of research methods and assessment techniques, and its presentation of a case study which demonstrates both the challenges and results of implementation.

2. Problem Formulation
VBA functions as an established programming language that operates inside Microsoft Office applications to automate repetitive work, while developers use it for creating specialized operational workflows. Research shows VBA produces productivity results across different fields because studies demonstrate businesses achieve better productivity results through its implementation. Studies show that businesses achieve 83.18%-time savings when they switch to automatic reporting systems (Kalwar et al. 2023). The main advantage of VBA exists because it allows users who lack

programming skills to build working automation solutions through its extensive set of functions, which handle data operations and process management, and interface creation.

VBA offers significant advantages to insurance operations by automating structured data-processing tasks, which many organizations lack sufficient technological infrastructure to handle. From empirical research, the following two benefits have been identified in the use of VBA. There is a reduction in processing time, and the accuracy of the reports has improved (Kalwar et al. 2023). The potential for managers to use the sophisticated analytical capabilities of the system to assist them in analyzing their data, producing reports, and making better decisions to increase manufacturing efficiency, profit margins, and customer satisfaction (Nurprihatin et al. 2021; Andry et al. 2023). The data that has been collected from a number of studies has demonstrated that the use of VBA is a flexible tool that enables managers to automate the statistical analysis of their human resources data, which saves the verification process and therefore reduces administrative costs (Zhao 2023). The management of large-scale hydro-climatic data relies on computerized data handling systems that conduct complicated mathematical computations to generate reliable results (Loureiro and De Mello 2024). Insurance companies can develop tailored software applications using VBA, which helps generate software that meets needs, with the entire activity becoming more accurate while the costs associated with software development become cheaper (Allayla and Al-Ibrahimi 2025)., However, the system suffers from some shortcomings, especially when handling large-scale datasets, as well as when it comes to real-time computations(Loureiro and De Mello 2024).

VBA is presented in this study as a flexible tool that helps in saving time through the linking of existing systems and the aim of processing optimization. The automation technology in VBA removes the human errors that exist in the post-order costing analysis processes (Kalwar et al. 2023). This is evidenced by the fact that small and medium-sized enterprises that do not have IT capabilities can opt for VBA, which acts as a low-cost substitute for the ERP system (Rahman et al. 2024).

The introduction of Excel macros to clean the data has resulted in a reduction in the amount of time required to perform such activities within the medical field. This has also enhanced the quality of the data that they are processing. The findings in the study have shown that the use of macros produces better results than humans in the process of extracting disorganized data from previous medical record analysis (Bauzon et al. 2025). In addition, the healthcare industry estimates that roughly 40% of the total pre-processing time on any analysis will come from data cleaning, thus indicating that there is a large benefit to improving the productivity of healthcare's data cleaning process (Islam et al. 2023). The findings have also shown that the errors associated with the use of macros can be prevented by programming to improve data extraction results (Bauzon et al. 2025). The findings have shown that the use of Macros can serve as an effective tool in the handling of large amounts of data by offering users the best data collection support system.

Table 1 shows the information regarding the implementations of the VBA systems used in the different sectors of the organizations; the use of VBA systems in the design of the insurance company's systems is not covered in the current literature. The current literature is focused on the performance aspects; however, the methodologies for the design of the VBA systems are not provided. The research uses the design tools of the systems, like Use Case Diagrams, Activity Diagrams, and Wireframes, in the design of the VBA macros. The quality of the systems is determined through the evaluation of the functionality, usability, accuracy, and performance of the systems.

Table 1. Related works

No	Author	Development Methodology	Requirement Elicitation Method	Designing Method	Development Phase	Testing Method	Maintenance Method
1	(Abdullah et al. 2022)	Waterfall	- Survey - Interview	- Relational Diagram - Hierarchical Diagram	- PHP - Larvel - MySQL - JavaScripts	Functional Testing	Regular Software Update

No	Author	Development Methodology	Requirement Elicitation Method	Designing Method	Development Phase	Testing Method	Maintenance Method
2	(Santonanda et al. 2022)	Waterfall	- Observation - Interview	- Business Model Canvas - Use Case Diagrams - Class Diagram Design	Java	Black Box Testing	Regular Software Update
3	(Bauzon et al. 2021)	N/A	Document Analysis	N/A	VBA	- Unpaired t-test - Accuracy	N/A
4	(Indarti et al. 2021)	Waterfall	Software Analysis	- Use Case Diagram - Activity Diagram - Entity Relationship Diagram - Logical Record Structure - Sequence Diagram	Java	Black Box Testing	Regular Software Update
5	(de Lange et al. 2020)	Model-Driven Web Engineering (MDWE)	Web-based MDWE	- Architectural Diagram - Wireframing	- HTML5 - JavaScript - RESTful	- Functional Testing - Usability Testing	Regular Software Update
6	(Weyuker and Vokolos 2000)	N/A	N/A	Architectural Diagram	N/A	Performance Testing	N/A
7	This Paper	Waterfall	- Observation - Interview	- Use Case Diagram - Activity Diagram - Wireframe	VBA	- Functionality Testing - Usability Testing, - Performance Testing - Accuracy	N/A

3. Methods

The Waterfall model is defined as a conventional software development methodology that follows the linear sequence of phases in software projects, which has remained prominent since the 1970s (Chandrika 2025). Being a structured software methodology, the Waterfall model follows different phases with tight control requirements related to documentation, time, and control in software engineering (Nurprihatin et al. 2023; Wisidagama and Marikkar 2024). The course of development consists of a definite number of stages, which are self-contained and have no repetition or overlap of phases.

In the Waterfall approach, the workflow proceeds linearly, with one stage building on the previous one, producing new work based on the previous stage's results. The stages, which are the same in all sources, are:

1. Requirements analysis
2. System design
3. Implementation/development
4. Testing/verification
5. Deployment
6. Maintenance

It has a very linear flow of activities, which is ideal for planning and execution. This ensures a structured and predictable process of development. However, this model may not work very well in a situation where changes occur very fast. There will be a rise in the use of a combination of different models in the coming years (Eyieyien et al. 2024). This is because the organization will move ahead only when the current phase is achieved.

The heart of software engineering is requirement analysis, which is the key step that assists the developers in creating software that meets the user requirements (Andry et al. 2020; Hidalgo et al. 2025). These requirements form the basis of the design stage, which defines architectural structures and technical designs of the system (Abdullah et al. 2022). This is followed by the implementation stage based on the design documents approved (Santonanda et al. 2022). The verification/testing stage comes into play as the next step, which involves the detection of system flaws and the validation of software adherence to the specified requirements (Alphonce 2024). The stage of proceeding forward has to overcome the challenges that come up in the implementation stage. The stage of maintenance involves proactive approaches, which include system observation and data analysis for improving the system's performance and its reliability (Khan et al. 2025).

The Waterfall model benefits the user through its step-by-step procedure. This model has been recognized as the most suitable model for all processes of software development because it helps the developers create plans for the projects and control the projects during the whole development process (Tong et al. 2023). This model works through a systematic procedure. This procedure helps the users track the progress of their work through a systematic path of steps that follow a certain order. This model offers the users excellent control functions. However, the model does not allow users to adapt easily to the changes in the project (Wisidagama and Marikkar 2024). The development methodology for this research is based on the Waterfall model, to develop a VBA tool for an insurance company. The Waterfall model is a sequential and structured approach that suits the project as it has defined requirements and limited scope.

4. Data Collection

4.1 Requirements Elicitation Phase

The research begins with requirement elicitation procedures, which help the team identify operational problems and user demands that existed in the insurance company that took part in the study. The research team collected data through their direct work with two essential operational units, which included the claims department and the finance and accounting department, through semi-structured interviews and direct observation. The system combined dual feedback approaches, which gave users the ability to observe system operations through their eyes and by working with the system interface.

User needs were collected by conducting interviews and information about operational challenges was obtained. Interview. The interview is a useful artificial language technique, which enables people to speak face to face and while they develop an insight of business need (Obaidi et al. 2025). The process of requirement elicitation required interviews to discover sources of information and system operational goals, system needs, or solution validation against anticipated results. There are 5 (five) key questions that are used to evaluate document enhancement methods by the claims department: workflow and document management practices, checking for accuracy and tool use, and challenges associated with manual performance.

Observation was added as an additional value to interview data, and it helped fieldworkers to watch how workers were doing their job and the system in use. Observational techniques are effective tools that this paper uses to analyze system operations and processes, which users often attempt to conceal. These techniques can help identify various bypass schemes and patterns. In principle, such patterns may be recognized even without a comprehensive understanding of the underlying dynamics (van der Waal et al. 2025).

4.2 Design Phase

The design phase of the system came after validating the requirements, converting user requirements into an organized solution that would work in VBA. The design targeted three aspects: system functionality, workflow architecture, and user interface.

The initial phase was to define the functionality of the system by utilizing a Use Case Diagram, which enables the identification of the functions of the system as well as the documentation of the features and pathways that users will

take to interact with the system, before the commencement of the development of the software (Molla et al. 2024). Once the functionality and pathways to be used had been established, the Developers were then required to create Activity Diagrams to depict the operation of the system, and the workflow paths the system will facilitate (Esiefarienrhe and Moemi 2024). The Activity Diagrams also provide the users with a direct way to identify tasks that require other tasks, as well as how the entire workflow operates. The creation of the wireframes, which was the third phase of the interface design process, provided developers with the visual representation needed to build the organizing structure and function of a UI as it relates to user experience while improving collaboration among all stakeholders (Almani and Alrwais 2024). The method reduced both the system development challenges and the time that users needed to understand the system.

4.3 Implementation/Development Phase

The development stage required the team to build the VBA-based tool according to specifications that received official approval. The development of products needs designers and manufacturers to make decisions together while they must connect the demands of stakeholders with the actual process of building things (Eyeregba et al. 2024; Koroth et al. 2024). Microsoft Excel served as the main platform on which VBA was used to perform task automation and create personalized spreadsheet functions. Automation systems help various operational tasks, which span from analog operations to digital ones and from manual work to automated processes to simplify operational tasks (Sulistiyo et al. 2023). The programming code achieved better readability and maintainability, and scalability through established best practices, which also allowed future enhancements to be easily implemented.

4.4 Testing/Verification Phase

The development process reached its endpoint, so developers began systematic testing of the VBA tool to check its operational status and user-friendliness, and speed against what the organization needed. Three testing methods are applied:

1. The process of functional testing checks whether system features perform their intended functions by analyzing grid-forming converter specifications and developing alternative methods for equipment certification and model validation (Ghimire et al. 2025).
2. Usability testing serves to assess software interfaces through the detection of user experience problems, which it uses to gather complete user feedback and determine how well users accept the tool (Gomes et al. 2024).
3. The measurement of the performance of the system through testing techniques helps to assure the organization that it will behave as expectedly while meeting efficiency standards (Pargaonkar 2023).

4.5 Deployment and Maintenance Phase

The insurance company deployed its VBA tool through the operational environment after developers finished software testing successfully. The maintenance phase requires continuous attention because it needs regular system monitoring and software updates, and bug resolution to maintain system operation at its best (Liao 2024). The solution received functional updates through stakeholder feedback, which also added new operational requirements that will continue to support system functionality in the future.

5. Results and Discussion

This research uses five VBA automation tools, which operated inside an insurance company to solve time-consuming manual tasks that included Medical Benefit Report (MBR) and Claim Individual Daily Report and Claim Group Daily Report and Payment Document Automation, and First Payment Proposal (FPP) Generation. The data processing system used manual methods before automation because it needed people to extract data and perform filtering and calculations, and create documents, which led to longer processing durations and greater chances of making mistakes.

5.1 Requirement Elicitation

The system requirements emerged through discussions with two essential business units, which include the Claims Department and the Finance and Accounting Department. Each VBA project was defined based on specific operational needs, with clear functional objectives and departmental ownership. The system requirements from Table 2 demonstrate which data entry methods users need to operate the system, while showing the processing flows and output data appearance, and the user interface design that enables users to complete their work requirements.

Table 2. System requirements

VBA Project	System Requirement	Department
MBR Report	a. System shall be able to import one .xlsx file type as data source. b. System should be able to clean data sources before being processed. c. System shall be able to filter data. d. System shall be able to copy the filtered data to the new workbook. e. System shall have User Interface	Claim

Table 3.Use case diagram

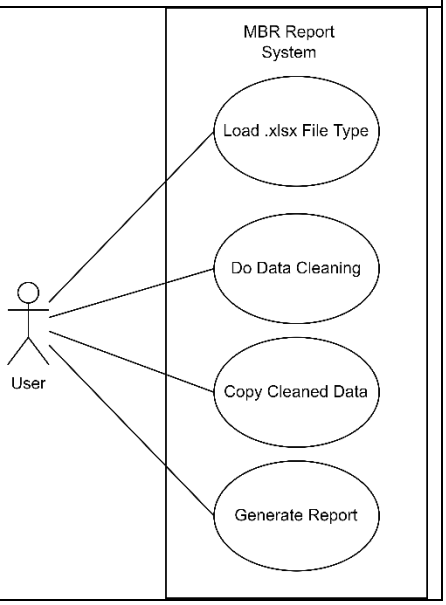
No	VBA Project	Use Case Diagram
1	MBR report	

Table 4. Workflow diagram

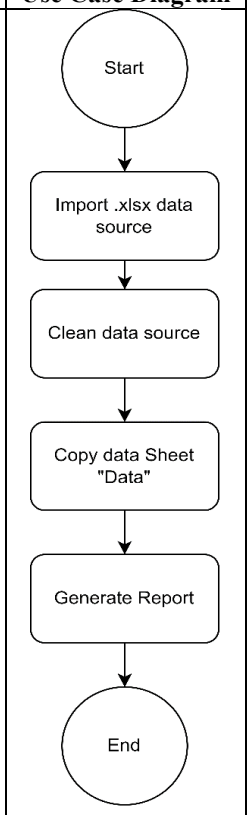
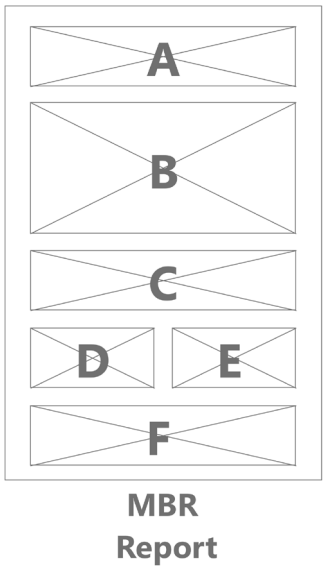
No	VBA Project	Use Case Diagram
1	MBR report	

Table 5. Wireframe

No	VBA Project	Wireframe Design
1	MBR Report	

5.2 Program Designing

The system design process uses a modeling system that includes Use Case Diagrams and Activity Diagrams, and Wireframes as demonstrated in Tables 3, 4, and 5, respectively. The system functionality and user interface for each project became clear through Use Case Diagrams, which we used for definition. The activity diagram was also utilized to show the flow of processes within the system, thus helping to explain the logic behind the processes. Wireframes were also developed by the team to show the interfaces, thus allowing access by users who are not technology experts.

All projects used common interface design elements, including corporate design, user guidance, and action buttons for data import and report generation. This ensured the system maintained operational consistency and the MBR and claim reports, payment automation, and FPP generation modules functioned as separate functional units.

5.3 Development

The modules created for this comprehensive system have been developed in the same chronological order as all of the other modules, such as data cleaning, data importation, data transformation, and data reporting modules. Furthermore, document manipulation has been accomplished with the use of several Microsoft Excel functions, including GetOpenFilename() and Workbooks.Open(). Additionally, Excel Shapes have been utilized within the User Functions designs.

The MBR module utilizes automation for both medical claim data validation and medical report generation; thus, medical claims can be completely error-free before providing end users with the standard format reports. Furthermore, both the Claim Individual and Claim Group Daily Reporting modules utilize SSRS data for automatic data processing and provide data visualization/categorization capabilities without requiring any intervention from end users for file categorization or calculations. Furthermore, the Payment Document Automation module uses automated processing to convert unstructured text to composite financial documents capable of being copied into spreadsheet format, which results in the ability to also be able to generate identical PDF documents. Finally, the FPP Generation module uses the First Payment Proposal generated from converted claims data to produce outputs for review by an approver.

5.4 Software Testing

To verify system functionality involves 3 (three) types of testing, such as functional testing, user testing, and performance testing. Functional testing is an indication that each module functioned as expected and produced accurate results, as shown in Table 6. The usability testing process examines how simple users found the system to

operate while assessing the interface design and their overall satisfaction with the application, which reveals no major usability problems, as shown in Table 7. Performance testing evaluates system response speed during normal operations, which shows that all system components achieve major reductions in processing times according to Table 8. The data from Table 9 shows that automation technology brought about major decreases in processing durations for four different reports. The system performance depended on hardware specifications which included RAM capacity and storage type and processor speed and GPU acceleration capabilities to achieve better system response times.

Table 6. MBR report functional testing

No	Process	Response	Status
1	User clicks “Update Data I” and “Update Data I” Button	Verify that the system can successfully import an .xlsx file	Success
2	User clicks “New Data” Button	Test that the system can correctly identify and remove unwanted data	Success
3	User clicks “Export Data” Button	Test that the system can correctly copy the filtered data to a new workbook	Success
4	User displays open “MACRO” sheets	Test that all features of the system are easily accessible and intuitive to use	Success

Table 7. MBR report usability testing

No	Process	Response	Status
1	User is provided with User Instruction.	Test the user-friendliness of the import process, such as ease of finding and selecting the file to import, clear error messages when the file cannot be found or loaded, and efficient handling of large files	Success
2	Macro provides UI for “New Data” Button	Test that the interface for selecting and deselecting fields to remove is intuitive and user-friendly	Success
3	User clicks “Update Data I” and “Update Data G” Button	Test that the system is easy to use when selecting and naming the new workbook, and that the copied data is correctly formatted	Success
4	The selection of color and the font of UI using Wireframing Technique	Test the layout and design of the interface to ensure that it is visually appealing, easy to read, and user-friendly	Success

Table 8. MBR report performance testing

No	Process	Response	Status
1	User clicks “Update Data I” and “Update Data I” Button and use dummy data.	Test the system's ability to import large .xlsx files quickly without errors or crashes	Success
2	User clicks “New Data” Button and count the processing time.	Test the time it takes the system to clean large datasets, and verify that it does not cause the system to crash or become unresponsive	Success
3	User clicks “Update Data I” and “Update Data I” Button and use real data.	Test the performance of the system when filtering large datasets, such as the time it takes to apply filters and the ability to handle complex filter criteria without crashing or becoming unresponsive	Success
4	User clicks “Update Data I” and “Update Data I” Button and count the processing time.	Test the performance of the system when copying large datasets to a new workbook, such as the time it takes to complete the copy operation without errors or crashes	Success
5	User opens the Macro file (.xlsm file format)	Test the performance of the system when displaying the user interface, such as the time it takes to load the interface, the responsiveness of the interface when interacting with it, and the ability to handle user input without crashing or becoming unresponsive	Success

Table 9. Saving summary table

No	VBA Project	Before VBA Implementation (mins)	After VBA Implementation (mins)	Saving Percentage
1	MBR report	45	10	77.78%
2	Claim Individual Daily report	60	5	91.67%
4	Payment Document Automation	10	3	70.00%
5	FPP Generation	10	2	80.00%

5.5 Maintenance

During the maintenance stage, systems undergo continuous monitoring while developers address bugs and optimize performance through small adjustments, which enable systems to adapt to changing user needs. The focus of this study is on design, development, and evaluation of a short development period, while excluding the maintenance phase.

6. Conclusion

Businesses today are forced to eliminate manual operational processes due to the need for automated systems to improve their operational efficiency. The paper centers its discussion on business process automation as its main topic. The insurance industry faces major challenges because it needs to modernize its operations while following multiple recently established laws and regulatory requirements. Organizations in the insurance industry face two main obstacles when trying to automate their processes because new technology integration with existing software systems requires them to spend substantial amounts of money while dealing with complex implementation procedures. The article demonstrates that organizations will not achieve their intended goals when they digitize their manual operations or automate their existing processes. The goal needs an extended and expensive series of steps to reach completion. The insurance company solved its problems through the development of an Excel VBA program. The assessment procedure for the four applications involved evaluating time-saving efficiency to establish their value. This showed that the applications were able to save time by various percentages, while the computer hardware parts were responsible for the efficiency with which they functioned. Hardware specifications that meet the sophisticated needs are required by insurance bodies for VBAs to successfully implement. The study in question provides evidence to demonstrate that the implementation of VBA software will allow for greater automation, and thus improved operational efficiency, between Insurance companies. Additionally, the findings of this study illustrate a range of

obstacles facing the implementation of VBA; and therefore, developers will need to create more sophisticated approaches to achieving the desired level of operational efficiency within their organizations, as well as utilizing highly advanced computer systems. The findings presented herein support the assertion that "Digital Transformation" represents the most viable opportunity for insurers to adapt to the evolving marketplace of the future and maintain their market position.

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