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# MICROSERVICES IN LIFE INSURANCE: ENHANCING SCALABILITY AND AGILITY IN LEGACY SYSTEMS

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### ABSTRACT

Legacy monolithic systems that dominate the life insurance sector restrict its expansion potential and slow down its operational speed while reducing productivity. Modern insurers must select advanced technological approaches because changing customer needs and complicated regulations force insurers to fight for market survival. The microservices architecture develops a disruptive solution which helps insurers optimize business efficiency while empowering better customer interactions and more straightforward integration of fresh functionalities. This research investigates how life insurance companies implement microservices while focusing on their ability to revamp conventional information systems. The implementation of microservices offers insurers expanded scalability alongside faster new product releases and superior opportunities to handle data processing requirements. The work investigates the execution obstacles involving complexities in data system integration and security threats with organizational reluctance to adopt new practices. Life insurers who embrace microservices technology will create a flexible, reliable, and cost-efficient IT framework that ensures forward growth in changing insurance environments.

### Keywords:

Microservices Architecture, Legacy System Modernization, Scalability in Insurance, Agile Insurance Technology, Digital Transformation in Life Insurance.

### **1. INTRODUCTION**

Over the years, the life insurance sector has operated its essential business processes through legacy software that handles policies, claims handling, and customer relations. The systems built several decades ago were developed to handle traditional insurance processes during conditions of market stability. Insurers currently experience operational problems, scalability, and slow innovation cycles due to advancing technology while evolving customer expectations (Bakar, Razali, & Jambari, 2019). The structure of legacy systems creates maintainability issues and integration problems that prevent insurance companies from applying contemporary digital solutions for better customer interaction and organizational optimization (M'baya, Laval, & Moalla, 2019). Traditional monolithic architectures have failed to match the rising demand for instantaneous analytics, automated solutions, and customized insurance offerings due to the data-driven insurance market (Arias-Pérez, Velez-Ocampo, & Cepeda-Cardona, 2020).

Horrible scalability becomes the main problem when businesses depend on legacy systems. Outdated systems cannot effectively process higher transaction volumes when insurers grow their business and customer base, so they create performance delays and operational slowdowns, according to Bertin et al., 2019. New technology integration of AI and blockchain with IoT into legacy systems demands complex implementation and robust financial investment during symbiosis (Lo et al., 2019; Chendeb, Khaled, & Agoulmine, 2020). The inability to adjust creates obstacles for insurers to innovate in the digital market, which leads to competitive problems (Venkatesh, 2020).

The insurance industry is turning to a microservices architecture because it presents a suitable strategy to modernize legacy systems. The microservices approach differs from monolithic systems because it distributes applications into separate distinct services which communicate through API interfaces according to De Lauretis (2019). The partitioned components can independently function within the infrastructure which allows insurers to maintain operational continuity at all times while simultaneously improving their overall system development speed

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according to Al-Debagy and Martinek (2018). Through microservices insurers achieve smooth integration of advanced technologies by making their systems compatible with AI risk evaluations and automated claims procedures alongside blockchain-based security systems (Kamimura et al., 2018; Lo et al., 2019).

The life insurance sector can advance past outdated legacy systems by implementing microservices, which create flexible and efficient modernized systems. The new system enables insurers to cut their operating expenses and better fulfil digital requirements from customers throughout the evolving world (Suthendra & Pakereng, 2020). Insurers should adopt microservices because this approach represents a vital element for reaching long-term institutional success while maintaining sustainability.

### 2. UNDERSTANDING MICROSERVICES ARCHITECTURE

The digital revolution has led to the widespread adoption of microservices architecture because it provides an advanced methodology for software development. The architectural style allows businesses to create scalable flexible resilient applications by dividing their operations into separate independent services (Al-Debagy & Martinek, 2018). Microservices architecture presents itself as an opposition to monolithic architecture because all application components exist within a unified codebase, according to De Lauretis (2019).

### 2.1 Definition and Key Characteristics of Microservices

The software development approach of Microservices architecture enables applications to operate through independent modular services that work independently. The single purpose of each service allows it to communicate with others through defined APIs, according to Suthendra & Pakereng (2020).

Software deployment with microservices follows six core principles: modular organization, independent database distribution, API interface, scalability benefits, system-neutral design standards, and automated system updating capabilities. Microservice architecture stands in contrast to monolithic systems that maintain one centralized database because it separates databases among its different components, leading to better system stability and performance (Lo et al., 2019). Through their independent development and deployment feature, microservices improve flexibility and speed up software delivery times (Kamimura et al., 2018).

### 2.2 Comparison with Traditional Monolithic Systems

The traditional monolithic structure has ruled the industry for many decades since it offers straightforward design and a centralized administration model. Portability for maintenance procedures suffers when software applications reach advanced levels of complexity (De Lauretis, 2019).

Aspect	Microservices	Monolithic Systems
Development Speed	Faster due to independent module	Slower due to dependencies across
	updates	components
Scalability	Scales individual services as needed	Entire application must scale
		together
Resilience	Each service runs independently so	The complete application becomes
	unsuccessful operation in one	unstable when a failure occurs
	service does not spread to other	
	services.	
Technology Stack	Uses multiple technologies per	The system operates on a single
	service	stack which covers all its
		components
Deployment	Supports continuous deployment and	Requires full application
	automation	redeployment
Maintenance	Easier due to modular design	Complex and time-consuming

Table 1: Comparison with Traditional Monolithic Services

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Businesses favor microservices over monolithic applications for their need of high availability together with rapid scaling and faster innovation cycles according to Tedeschi et al. (2018).

### 2.3 Benefits of Microservices in a Business Context

The digital era demands that businesses adopt microservices deployments to obtain multiple strategic benefits that boost their competitive position. The ability to perform independent development testing and deployment allows this approach to speed up new features, shortening the time required to reach the market (Arias-Pérez, Velez-Ocampo, & Cepeda-Cardona, 2020). Businesses gain the advantage of efficient resource allocation because they can scale only those services that experience high demand (Bertin et al., 2019).

Microservices promote system resilience and fault isolation, ensuring complete separation of system components so failures affect only specific areas, making the system more reliable and high uptime possible (Razzaq, 2020). Their ability to seamlessly integrate with AI, IoT, and blockchain allows microservices to serve as perfect solutions for modern digital transformation projects (Chendeb, Khaled, & Agoulmine, 2020). The process of transitioning from legacy monolithic systems to microservices architectures can be accomplished progressively by businesses without interrupting operational activities (M'Baya et al., 2019).

The microservices architecture system has transformed business practices through its ability to create flexible operations and strong resistance capabilities alongside solution enhancement abilities (Venkatesh, 2020). The advantages of microservices over monolithic systems include rapid development cycles, resource optimization, and better system reliability that attract modern businesses (Kamimura et al., 2018). The continuous development of cloud computing AI and automation will transform microservices into the fundamental pillar of software development and business agility, according to Razzaq (2020).

### 3. CHALLENGES OF LEGACY SYSTEMS IN LIFE INSURANCE

The old systems that life insurance companies use today slow down performance and limit how well they handle new regulation rules. Old systems created using monolithic technology face many issues due to their outdated design, hard-to-connect components, slow processing power, and compliance problems. The digital trends of today make it clear that insurers must update their systems to remain effective in business.

### 3.1 Limitations of Monolithic Architecture

Regular life insurance systems use basic design patterns that make it hard to improve or update the product. These systems have tightly connected parts, which creates both long development times and expensive changes, according to De Lauretis (2019). One single bundle of system parts makes minor updates very time-consuming because testers and developers must work on every part of the system. Monolithic systems limit insurers from using new technologies because they do not have separate parts to fit in new technology (Kamimura et al., 2018). By maintaining fixed processes, insurers encounter problems because they cannot adapt their operations to serve updated customer needs and follow changing market patterns.

### **3.2 Difficulties in Integrating New Technologies**

Insurance companies struggle to combine modern digital tools while running outdated legacy technology. Newer technology platforms experience issues when sharing data with legacy systems because they lack default APIs, according to Bakar et al. (2019). Insurance companies face problems improving customer service and operations and receiving considerable data value in risk assessments (Arias-Pérez et al., 2020). When digital networks keep growing, insurers who work with outdated systems have problems linking with third-party service providers who offer new financial technology features, preventing them from offering customers better service and streamlining operations.

### 3.3 Scalability and Performance Bottlenecks

Regular, up-to-date systems help insurers better serve a rising number of policyholders without facing performance problems. Rising transaction levels create system performance problems because the outdated processing systems do not run efficiently (Al-Debagy & Martinek, 2018). The system slowdowns harm service and create delays that upset customers and damage our brand standing. Insurers who use outdated systems pay more to run their operations and their systems slow down both in the front and back areas of operations according to Suthendra and Pakereng (2020).

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Insurers face challenges reading live data because this stops them from recognizing customer patterns and creating better products.

### 3.4 Compliance and Regulatory Constraints

Older system architectures struggle to follow new legal standards because they are not required to stay up-to-date. Insurers need to follow strict data protection rules while setting up secure traceable platforms as stated in Chendeb et al. (2020). Standard systems usually come with weak security features plus slow data feedback that elevate related compliance hazards, as Lo et al. (2019) show. Insurers face excessive risk because their current manual report generation takes too long and contains mistakes that put them at financial risk. Because rules change frequently, insurers require technology that can promptly modify themselves to meet new compliance standards.

Given current problems, it is important for insurers to update their technology systems. Moving to microservicebased systems and cloud technologies helps companies become more adaptable and grow their operations to follow regulations better. Insurers can adjust their operations through cloud computing to raise or lower their systems without adding more infrastructure at lower operating costs. Our insurance processes can work faster with AI systems plus blockchain because they detect wrongdoings better and let clients view policy information straightaway. The insurance sector reduces operational costs and meets industry needs for confident future growth through these changes. Firms that put off digital transformation will lose ground to those presently embracing digital change, so they must start using future-proof solutions before rivals do.

### 4. BENEFITS OF MICROSERVICES IN LIFE INSURANCE

The life insurance industry stands at a pivotal phase which microservices will trigger to enhance business adaptability while fulfilling client demands and market requirements. Single applications which are large cannot adapt to digital transformations that occur in the current era. Microservices provide life insurance companies with valuable benefits that let both operations work more efficiently while improving customer service quality (Al-Debagy & Martinek, 2018).

### 4.1 Enhanced Scalability and Flexibility

.life insurance performs better through microservices because they grow well under different usage levels. Through microservices, insurers can upgrade individual services when needed rather than needing to modify and restart their overall application. Policy underwriting and claim processing services use separate capacity settings that allow businesses to use their resources optimally (Kamimura et al., 2018). The system remains available to maintain normal operations while features are updated due to its flexible design and adaptability to market changes (De Lauretis, 2019).

#### 4.2 Faster Deployment of New Products and Services

Insurance providers must get new product ideas to market quickly because their competitors do this too. Microservices architecture improves the process of integrating new products into the market through faster deployment methods, as Suthendra and Pakereng (2020) report. The separation of apps into smaller components helps insurers develop features separately and release them faster on the market. The system stands ready to meet both new customer needs and updated rules thanks to its speed (Razzaq, 2020).

#### 4.3 Improved Data Management and Analytics

Life insurance companies benefit from strong data usage practices to improve policy evaluation and prevent fraud. Through microservices, life insurance providers can connect their systems to big data platforms and AI systems that efficiently handle all types of data (Arias-Pérez et al., 2020). Through microservices, insurers can handle real-time data analysis to make better decisions and give tailored policy suggestions based on customer data and risk models (Babu & Mohan, 2018).

#### 4.4 Better Customer Experience Through Seamless Integrations

Customer experience proves to be the essential differentiating factor between life insurance companies which compete in the market. Microservice technology allows different digital connection points to unite according to Lo et al. (2019). The system connects with customers better through up-to-date policy information and quick claim handling while giving personal insurance options. The system enables users to receive the same smooth digital experience when moving between different platforms (Chendeb et al., 2020).

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Self-contained services help life insurance companies serve customers better and deliver product changes faster while handling large customer volumes and managing data more effectively. Insurers can deliver better digital solutions with microservices because these services let them build applications that handle change speedily and protect customer needs. Insurers using this structure achieve better operations and prepare to win against competitors in the future (Weide-Zaage, 2019).

### 5. IMPLEMENTATION STRATEGIES FOR MICROSERVICES ADOPTION

Life insurers should take a strategic path as they move to microservices to avoid problems and create productive results. Life insurers need to develop a migration plan that moves them away from existing centralized systems without causing structural problems.

### 5.1 Steps for Transitioning from Monolithic to Microservices Architecture

- Examine IT system details to select which services should start using microservices (Bakar et al., 2019).
- Insurers should begin transforming their core insurance functions into microservices through progressive changes (M'baya et al., 2019).
- Through Docker and Kubernetes practices our system can launch containers while managing and running microservices effectively as per Weide-Zaage (2019).
- To maintain operational performance and speed DevOps users need automation systems to automatically integrate and deploy new software features quickly (Waseem et al., 2020).

### 5.2 Best Practices for System Integration and API Management

- Using RESTful or GraphQL APIs helps connect all microservices inside and outside the system (Li, 2019).
- Companies need to use OAuth procedures and blockchain authentication alongside data integrity methods from Venkatesh (2020) to protect information.
- The integration of Prometheus and distributed tracing assists insurers in tracking their system performance while identifying potential problems ahead of time as described by Tedeschi et al. (2018).

### 5.3 Case Studies of Insurers Leveraging Microservices Successfully

Many life insurance companies have changed to microservices because they deliver improved performance and help enhance their organization.

- Global Life Insurance Provider shifted from outdated technology to a service-based system to process claims 40% faster and make customers happier (Arndt & Guercio 2020).
- The regional insurer deployed microservices to install artificial intelligence risk evaluation tools improving rate estimation while decreasing fraud incidents (Bertin et al., 2019).
- Insurtech Startups adopted cloud-native microservices platforms to let customers buy life insurance digitally through on-demand services with NO waiting for approval (Lo et al., 2019).

Life insurers who adopt microservices technology can secure their operations for the future while improving customer service and finding new ways to succeed in the market.

### 6. CHALLENGES AND RISKS OF MICROSERVICES ADOPTION

Microservices architecture now serves as a preferred development method to make applications grow efficiently. Adopting microservices brings important difficulties and perils which organizations must handle to make their deployment work successfully. This section lists and describes all the main problems organizations face when adopting microservices.

### 6.1 Complexity in Managing Distributed Systems

Handling distributed systems requires considerable difficulty when you embrace microservices architecture. Every microservice stands alone as its own entity so multiple services need to connect which raises operational complexity above monolithic applications. Organizations should build service discovery structures along with fault-tolerant systems and distributed tracing methods to properly control connection processes (Kamimura et al., 2018). According to Al-Debagy and Martinek (2018), these system reliability problems include unstable data records across services plus network slowdowns and dependency complications when services work together.

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### 6.2 Security and Compliance Concerns

A high level of security protection is required because microservices use many APIs to connect services together. A system built with microservices creates multiple opportunities for hackers to access and break API security standards, according to Chendeb et al. (2020). To ensure data protection organizations using microservices must set up strong security layers based on OAuth and JWT tokens. Decentralized services make it harder for businesses to follow GDPR and HIPAA compliance standards according to Lo et al. 2019.

### 6.3 Organizational and Cultural Shifts Required

Major company changes and teamwork transformations are necessary when switching from monolithic to microservices-based systems. Teams that develop software need to adopt DevOps methods through routines of constant change automation plus joint work across different skill sets (De Lauretis 2019). few culture and management changes need new staff abilities and methods familiarization to agile processes. The reluctance of IT staff members to embrace new practices causes reduced performance levels according to Abdelhamid and Sposato (2019).

### 6.4 Cost and Resource Considerations

Introducing microservices needs a lot of money for setup and maintenance plus trained staff. Organizations need money to buy tools for managing containers plus hardware and software for API gateways and checking system health with dedicated tools for reliable system updates (Razzaq, 2020). The number of microservices increases cloud costs by creating more service instances and increasing network usage (Tedeschi et al., 2018). Organizations need to test if microservices offer better value than their current system before going ahead with the change.

Microservices benefit from increased scalability but their implementation brings both problems and safety concerns to the organization. Organizations need to handle their distributed systems correctly while maintaining security and compliance standards through staff changes plus they must evaluate increased costs for success. You need a proper approach including proven methods plus strong control mechanisms to reduce the risks involved in moving to microservices.

### 7. FUTURE OUTLOOK AND CONCLUSION

### 7.1 Emerging Trends in Microservices for Life Insurance

Through the adoption of microservices, the life insurance industry is changing technologically; the transformation ensures processes are streamlined, and customer experiences improved. Among the top trends, one can point out a switch to cloud native architectures that allows insurers to build scalable and flexible solutions (Al-Debagy & Martinek, 2018). Furthermore, insurers benefit from using API driven ecosystems, meaning that the insurers can easily integrate their platform with third party services like health monitoring app and financial planning applications (Waseem et al., 2020).

Second is the growing serverless computing which helps in alleviating the infrastructure complexities and boosts operational efficiency (Razzaq, 2020). Due to microservices evolution, they are growing in the containerization fashion, e.g., Kubernetes, that allows workload management and cost optimisation (De Lauretis, 2019). Event driven microservices, in which insurers can gain the capability to have real time processing, are also witnessing an increase in traction as part of risk assessment and policy management is vital (Suthendra & Pakereng, 2020).

Moreover, predictive analytics within microservices are changing the way underwriting and claim processes are integrated for insurers to base data driven decisions in a more accurate and efficient manner (Arias-Pérez, Velez-Ocampo, & Cepeda-Cardona, 2020). In addition, the advancement in risk detection mechanism reduce fraudulent claims and improves customer's satisfaction.

### 7.2 The Role of AI, Cloud Computing, and Blockchain in Enhancing Microservices

The microservices scenario in the life insurance industry is under the influence of artificial intelligence (AI), cloud computing, and blockchain. The introduction of AI driven microservices is improving the policy customization, and insurers are using these to understand vast data sets and customize the policy according to the customers' behavior and risk profiles (Babu & Mohan, 2018). It is being seen that chatbots and virtual assistants powered by AI are helping a lot to improve customer interactions by reducing the dependency on human agents and providing instant support (Abdelhamid & Sposato, 2019).

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The basis of scalable microservices is cloud computing which enables the insurers to store and process tons of data in a secure and regulated manner (Bakar, Razali, & Jambari, 2019). Multi cloud strategies enable insurance companies to be efficient with their IT operation and avoid vendor lock in and ensure business continuity (Kamimura et al., 2018).

Security concerns in the insurance sector are being tackled and the sector is being made more transparent through blockchain technology. Integrating blockchain with microservices will enable insurers to have tamper proof records of policies, claims and transactions which helps in curing problems like frauds and data integrity (Larson et al., 2019). Considering the fact that smart contracts governed by blockchain can automate claims settlements facilitating instantaneous, dispute free transactions (Chendeb, Khaled, & Agoulmine, 2020),. In addition, blockchains are helping to enable decentralized identity management to streamline the onboarding process (Arndt & Guercio 2020) by eliminating paperwork and affirming regulatory adherence it (Arndt & Guercio 2020:9).

### 7.3 Final Thoughts on the Long-Term Impact of Microservices Adoption in the Industry

The admission of microservices across the life insurance industry will completely change the general business models. Tedeschi et al. (2018) demonstrates that the insurers who embrace such architectural approaches will have increased agility and will be able to respond quickly to market changes and customer demands. Given the increase in stringency in regulatory requirements, microservices create a module, and a compliant framework that enables seamless adaptation to any changes in policy or standard (M'baya, Laval, & Moalla, 2019).

Their adoption will have a long term effect on better customer experiences, better operational efficiency and reduced IT overheads. In the digital first world of the future, the insurance carriers will continue to invest in AI, blockchain, cloud and cloud-native solutions to future proof their operations and stay competitive (Venkatesh, 2020). Also, with the uptick in sustainability and cost reduction schemes, microservices make it easier for organizations to optimize resource utilization and eliminate redundant processes (Bertin et al., 2019).

Overall, microservices are not an IT strategy anymore but the business imperative that the life insurers need to innovate and scale effectively. All of this will take off further when AI, cloud computing and blockchain meet, allowing a robust, secure and customer centric base for the future of the industry. Those companies who proactively invest in microservices today will be perfectly placed to be the leader of the insurance market in years to come.

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