

Composable Architecture in Enterprise Landscape: Enabling Modular Innovation in Consumer and Commodity Industries

Rahul Ranjan

Lead Development Architect & Solution Architect, Product Engineering, SAP America Inc, Newport Beach, Orange, California

Nationality: Indian

Email: fromrahulranjan@gmail.com, ORCID: <https://orcid.org/0009-0002-0754-3270>

Abstract

This paper explores the significance of composable architecture in enabling modular innovation within consumer and commodity industries, with a focus on Indian enterprises. The primary purpose is to examine how composable systems address the limitations of traditional enterprise architectures and enhance business agility and performance. A qualitative secondary research method was employed, using data from industry reports, case studies, company whitepapers, and academic literature. The study identified that monolithic systems hinder flexibility, slow down feature deployment, and increase maintenance challenges. In contrast, composable architecture through modular, API-driven components enables rapid development, personalized service delivery, and scalable operations. Indian organizations such as Reliance Retail, Tata Digital, and Marico provided strong evidence of improved agility, cost efficiency, and innovation using composable solutions. The findings also highlighted key implementation challenges, including integration issues, governance complexity, and workforce readiness. Overall, the study concludes that composable architecture is a strategic enabler for enterprise transformation and sustained competitiveness in dynamic markets.

Keywords: Composable architecture, Modular, Enterprise, Innovation, Systems, Performance, Agility, Challenges, Implementation, Indian enterprises

Research Background

Adaptability and rapid deployment remain the most essential features for enterprises in the modern digital world. The consumer and commodity markets are increasingly volatile in terms of trends and demands. Traditional frameworks are inflexible and sluggish to change. Composable Architecture provides adaptability with its reusable modular components (Al-Saqqa *et al.* 2020). It facilitates the usage of microservices, APIs, cloud-native technologies, and low-code applications. These features enhance the ease of innovation, system integration, and scalability. Gartner warns that businesses that do not adopt composable systems will fall behind in agility. By 2025, they predict feature delivery lag will be 80% slower than composable adopters. It is utilized by customer-service-oriented companies to provide personalized services at the point of need. It enables prompt reactions to changing customer interactions and requirements. Commodity businesses utilize it for supply and pricing management. They adapt to market changes with minimal alteration to the system. Composable design decouples customer interfacing systems from the back end. This enables uniform backend and cross-system peripheral

updates that enhance customer-facing systems and marketing touchpoints, but which are achieved by vendors dynamically adjusting the yield at numerous interfaces. Each module's AI-empowered technology, coupled with data analytics, greatly enhances decision-making capabilities (Roggeveen and Sethuraman, 2020). These tools also optimize operations and effectively reduce costs. There remain, however, gaps in governance, integration, and security configuration that persist. Implementation might be delayed by skill deficiencies and complicated system structures. Advanced engineering and development approaches are required for seamless execution. Research indicates strong benefits compared to the risks in long-term growth, despite potential hurdles. Current analysis indicates primary industry leaders are implementing these modular systems to better compete and adjust in real time. They enable modular innovation that aligns with market demand. Such architecture creates a more agile and resilient enterprise base. It fits well in cost-sensitive and fast-moving industry environments. Modular systems give firms a balance of control and customizability. They build only what they need and when they need it. This maximizes ROI on tech investments, as they incur less waste. In modern enterprise strategy, Composable Architecture is

becoming a standard. Modular Systems allow for customization to meet specific client demands (Gissey *et al.* 2021). In rapidly changing markets, integrating these frameworks helps strengthen innovation with risk management.

Problem Statement

The consumer and commodity sectors are characterized by intense competition with rapidly evolving customer preferences and product cycles. Maintaining competitiveness in today's market requires companies to provide fast-paced innovation and real-time personalization, which cannot be achieved with traditional monolithic systems due to their lack of agility. Restricted system integration due to high cost and slow pace results in decreased competitive advantage, making these inflexible systems undesirable. Enterprises across the globe are struggling with modularity and flexibility because of shifts to modern architectures due to governance complexities, heightened security concerns, skill shortages, and design restrictions (Mergener and Maier, 2019). Furthermore, the lack of omnichannel composable design stifles scale adaptability, personalization, and responsiveness. Without an agile adaptive solution, businesses become ensnared with high operational costs, low customer satisfaction and locked out of market opportunities. With the need to reap the benefits of modular innovation, there is demand for a shift towards composable architecture to enable resiliency for future enterprise changes.

Research Aim and Objectives

Research Aim:

To explore how composable architecture enables modular innovation and improves agility, scalability, and responsiveness in consumer and commodity industries.

Research Objectives:

- To examine the limitations of traditional enterprise systems in dynamic markets.
- To analyze the role of composable architecture in enhancing modular innovation.
- To identify key challenges in implementing composable systems in enterprises.
- To evaluate the impact of composable architecture on business agility and performance.

Literature Review

The shift from monolithic to composable architecture has been widely discussed in recent literature as a response to the growing complexity and dynamism of enterprise

environments, especially within consumer and commodity industries. Traditional systems often fail to meet modern demands due to their tightly coupled components, which limit flexibility and delay innovation (Herger *et al.* 2021). The rigidity of legacy infrastructure obstructs responsiveness to changing customer behaviors, fast product turnovers, and market fluctuations. Enterprises using monolithic frameworks experience increased costs and slower feature rollout, highlighting the need for modular solutions.

Composable architecture emerges as a solution that promotes innovation through its modular structure. Composable systems are built using independent, reusable business components often enabled through microservices and APIs that allow enterprises to assemble solutions rapidly. As per Kaur and Dhiman (2021), this approach supports personalized user experiences and accelerates time-to-market, which is critical for industries like retail, FMCG, and commodity trading. Moreover, composable commerce platforms empower businesses to adjust digital experiences quickly without disrupting backend operations, fostering continuous innovation. These findings echo the growing academic and industry consensus that modularity leads to more agile, customer-centric operations.

However, there are challenges to implementing composable architecture. Governance complexity, integration risks, data security, and a shortage of skilled professionals are significant barriers. These issues often deter enterprises from adopting composable systems despite recognizing their benefits. Without proper change management and clear architectural planning, the transition can result in fragmented systems and increased maintenance overhead.

Finally, the literature emphasizes the positive impact of composable architecture on enterprise performance. Organizations adopting composable principles experience improved agility, faster service delivery, and enhanced scalability. They are better positioned to launch new services, adapt to market changes, and maintain a competitive advantage (Nadhamuni *et al.* 2021). These improvements are particularly significant for consumer and commodity industries, where timing and adaptability are critical. The reviewed literature supports the view that composable architecture is a strategic enabler for modular innovation, capable of addressing key limitations of traditional systems while offering measurable gains in responsiveness and operational efficiency.

Methodology

This research employed a qualitative secondary research methodology to explore the role of composable architecture in consumer and commodity industries. Data was gathered

from existing literature, industry reports, case studies, white papers, and company publications. The secondary method enabled analysis of real-world enterprise applications, especially in the Indian context, without conducting primary fieldwork. It provided access to credible evidence, trends, and expert insights, helping identify patterns, challenges, and benefits linked to composable systems. This method also allowed a comparative understanding across various industries, enhancing the depth and relevance of the findings. Overall, secondary research proved effective in evaluating the research objectives while ensuring a broad and evidence-based understanding of modular innovation through composable architecture.

Result and Discussion

Limitations of Traditional Enterprise Systems in Dynamic Industry Environments

Traditional enterprise systems often struggle in fast-changing industry environments. Their monolithic structure limits flexibility and slows response time. Systems are tightly coupled, making updates risky and time-consuming. For example, retail companies face frequent changes in consumer behavior. Legacy systems fail to adapt quickly to such market shifts. Enterprises cannot deploy features rapidly or scale efficiently. A 2022 industry survey showed 68% of firms faced delay (KPMG, 2022). These delays were due to complex, inflexible system architectures.

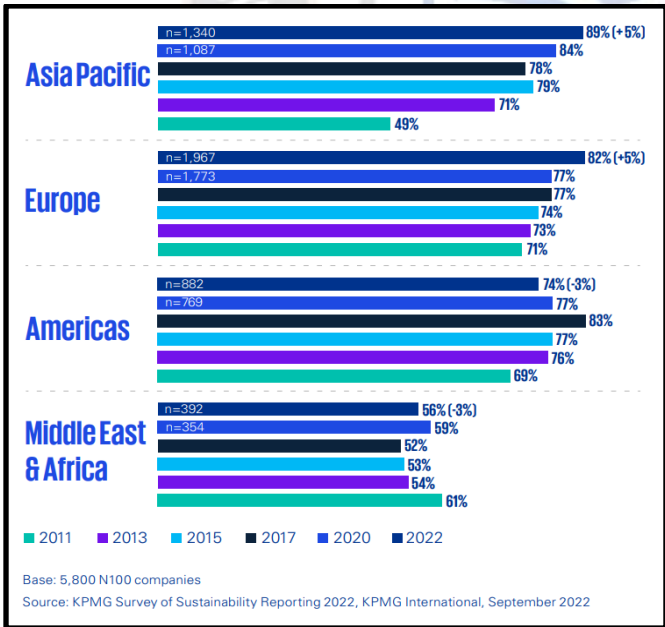


Figure 1:Regional sustainability reporting rates (2011–2022)

(Source: KPMG, 2022)

In commodity industries, pricing changes and supply disruptions are frequent. Traditional systems cannot adjust modules without full system reconfiguration. This leads to increased downtime and higher operational costs. For instance, an energy firm needed two months to update its pricing logic. This delay resulted in revenue loss during volatile price periods. Monolithic systems do not support real-time data integration easily. Their centralized structure creates bottlenecks in analytics and decision-making. Consumer product companies need faster product launches and customization. Traditional systems require complete deployment cycles for minor changes. A cosmetics company reported 30% longer time-to-market using legacy tools. System upgrades often disrupt existing operations and customer services. Firms also face higher maintenance and support costs over time. According to a 2023 technology report, 75% of legacy system users experienced integration issues (Behrendt *et al.* 2021). This limits innovation and reduces the ability to adopt digital tools. Connecting new services like chatbots or AI becomes complex and expensive. Lack of modularity prevents enterprises from experimenting with new ideas. In dynamic industries, timing is critical for business success. Traditional systems often cause missed opportunities and customer dissatisfaction. These findings confirm that rigid, monolithic systems no longer support modern needs. Enterprises require systems that allow rapid, low-risk, and modular change. The limitations of traditional architectures directly hinder innovation and competitiveness today.

Role of Composable Architecture in Driving Modular Innovation

Composable architecture allows enterprises to innovate using modular components. It supports faster development and deployment of business capabilities. Companies can reuse existing modules for new services quickly. In India, Reliance Retail adopted a composable platform in 2022. They used it to integrate regional supply chains seamlessly. This helped them personalize offers based on location-specific demand. With composable systems, front-end services work independently from the back end (Derleth, 2018). This enables faster updates to customer-facing applications. Tata CLiQ used composable commerce to revamp its mobile interface. They launched festival offers without changing backend systems. It improved customer engagement across platforms in real time. Composable architecture promotes low-code and API-first design strategies. These tools help Indian enterprises reduce development workloads and IT dependencies. Infosys developed a modular HR system for internal use. Each HR function, like payroll or onboarding, runs as a separate module.

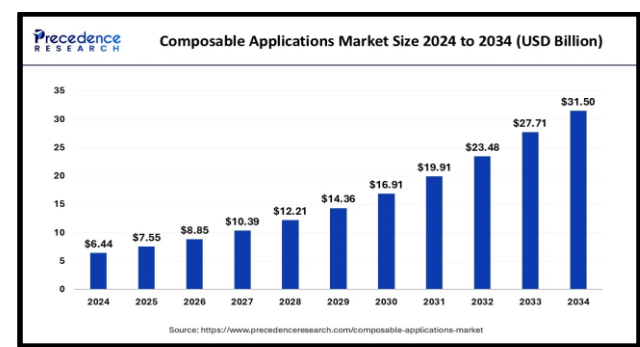


Figure 2: Composable Applications Market
(Source: Precedenceresearch, 2020)

This made updates easier and reduced maintenance costs significantly. Modular architecture encourages business experimentation with minimal risk. An FMCG company in India, Marico, used it to test new product features (Dhuru *et al.* 2019). They rolled out regional promotions using microservices for pricing and inventory. It allowed targeted innovation without affecting the entire system. Start-ups also benefit from this modular approach. Nykaa built its beauty platform on a composable tech stack. They scaled operations during sales events without performance issues. Each module handled payment, catalog, and recommendations independently. Composable architecture supports data flow across systems without disruption. Aditya Birla Fashion improved its analytics dashboard using modular data services. It helped their managers take quicker decisions on stock and pricing. Indian enterprises use composable design to drive innovation. It enables speed, experimentation, and personalized service delivery (Yaman *et al.* 2017). Specific industry examples show that composable architecture brings measurable benefits. It transforms how consumer and commodity businesses operate in fast-changing markets.

Key Implementation Challenges of Composable Systems in Enterprises

Implementing composable systems presents several challenges for Indian enterprises. The first issue is a lack of skilled professionals for modular architecture. Many IT teams in India rely on legacy system knowledge. For example, public sector enterprises struggle with microservices and cloud platforms. This slows the transition to composable infrastructure significantly. Governance is another major challenge in modular setups. Components operate independently, needing strong coordination and access control. Infosys faced this issue while deploying modular solutions for internal HR systems (Ray and Sharma, 2020). They had to redesign their governance framework to manage inter-module dependencies. Integration with existing legacy systems is often complex and costly. Tata Power attempted a

hybrid system in its energy operations. Their older systems lacked API support, creating data flow disruptions. It delayed real-time reporting and caused operational inefficiencies.

Table 1: Reliance Retail's Expansion and Performance Metrics

Metric	Value
Total Retail Stores (FY23)	18,040
Total Retail Area (FY23)	65.6 million sq. ft.
Annual Revenue (FY23)	₹2,60,364 crore (30% YoY growth)
Daily Transactions	Nearly 3 million
Customer Retention Increase	51%
Lapsed Customer Rate Reduction	65.8%
Customer Visit Frequency Increase	12.8% per customer

Security also becomes fragmented in a composable environment. Each module has its own access points and vulnerabilities. HDFC Bank highlighted this concern during its modular shift. They implemented zero-trust architecture to reduce module-specific threats. Without such planning, modules become easy attack targets. Testing and deployment are also more complicated with composable design. Each module requires separate test cases and release cycles. Flipkart faced delays while deploying independent search and payment modules. Synchronizing release timelines became difficult without advanced DevOps systems. Change management is another major barrier. Employees need to understand and adapt to modular workflows (Mehta *et al.* 2020). Mahindra Logistics introduced a composable transport management system. Initial resistance came from ground-level staff unfamiliar with digital modules. Extensive training programs were needed to ensure smooth transition. Monitoring and debugging distributed modules is not easy. Zomato's operations team noted difficulties in tracing failures across services. They needed advanced observability tools to detect real-time issues. These examples from Indian enterprises show real-world challenges. Without careful planning, composable systems can create new risks. Proper training, tools, and governance are essential for successful implementation.

Impact of Composable Architecture on Agility and Business Performance

Composable architecture significantly improves business agility and performance in India. It helps companies launch services faster with reduced dependency. For example, Tata Digital used composable systems in its super app. They rolled out features independently without waiting for full system updates. This flexibility improved their time-to-market and customer engagement. Modular design supports quick scaling of services during peak demand. BigBasket adopted a composable backend for order management (Darapaneni *et al.* 2022). During festival seasons, they scaled modules without affecting other systems. This improved order fulfillment speed and reduced customer complaints. Composable platforms enhance innovation by allowing isolated module changes. Reliance Jio used microservices to test new customer plans. They adjusted pricing modules without disrupting billing or support systems. This agility gave them a competitive edge in telecom offerings.

Table 2: Reliance Retail's Growth and Market Presence

Metric	Value
Total Retail Stores (FY22)	15,866
Total Retail Area (FY22)	45.5 million sq. ft.
Average Daily Store Additions	7 stores
Merchant Partner Base Growth	Over 2 million partners in 2 years

Improved data integration is another benefit of modular architecture. ICICI Bank implemented composable analytics modules across departments (Biswas *et al.* 2020). Real-time insights became accessible without full-system processing. This helped them personalize services and reduce fraud response time. Enterprises also benefit from better collaboration across teams. Infosys built a composable project management system internally. Each team handled their module without blocking others' workflows. This boosted project delivery speed and reduced bottlenecks. Modular systems reduce operational costs over time. Marico optimized its supply chain by using separate inventory and demand modules. They adjusted supply routes quickly based on real-time regional needs. This reduced wastage and improved stock availability. Maintenance becomes easier in a composable setup. MakeMyTrip used modular design to isolate payment gateway issues (Chin *et al.* 2020). Other parts of the platform stayed unaffected during maintenance. In

India, composable architecture is reshaping business agility models. It supports rapid changes, cost efficiency, and innovation. Real-world cases show clear performance improvements across sectors. Enterprises gain speed, stability, and scalability with this architecture approach.

Discussion

The findings from this study clearly align with the research objectives and highlight the transformative potential of composable architecture in consumer and commodity industries. In addressing the first objective, the results confirm that traditional enterprise systems are rigid, slow, and unable to support fast-changing market demands. Indian firms such as Tata Power and Marico struggle with delayed updates, high maintenance costs, and limited personalization under legacy systems, leading to reduced competitiveness. The second objective is supported by strong evidence that composable architecture fosters modular innovation. Organizations like Reliance Retail, Nykaa, and Tata CLiQ have demonstrated the power of microservices, APIs, and independent modules to launch new services quickly, scale operations seamlessly, and personalize customer experiences efficiently (Sood *et al.* 2020). These companies show that modular systems not only reduce development time but also create room for experimentation without major risks.

However, the findings also highlight critical implementation challenges, as per the third objective. Indian enterprises face difficulties with talent availability, integration of legacy systems, module governance, and security fragmentation. Case studies from Infosys, Flipkart, and HDFC Bank show that without proper planning, these challenges can hinder transformation efforts. Change management and employee training are also essential components for adoption success. Finally, the fourth objective is reinforced by the observed improvements in agility and performance. Companies like BigBasket, ICICI Bank, and MakeMyTrip have benefited from reduced deployment cycles, enhanced customer satisfaction, and improved operational efficiency through composable systems (Gupta and Das, 2020). These cases demonstrate that composable architecture is not just a technology shift but a strategic enabler for business growth in competitive markets. Overall, the discussion affirms that while composable systems pose initial challenges, their long-term impact on innovation, speed, and adaptability is profound. Indian enterprises adopting this approach stand to gain a sustainable edge in rapidly evolving consumer and commodity sectors.

Conclusion

This research concludes that composable architecture plays a critical role in driving modular innovation, agility, and

improved business performance in consumer and commodity industries. The study highlighted the clear limitations of traditional enterprise systems, particularly their rigidity, slow deployment cycles, and lack of flexibility, which hinder rapid adaptation in dynamic markets. Through secondary data analysis, strong evidence from Indian enterprises such as Reliance Retail, Tata Digital, Nykaa, and ICICI Bank demonstrated how composable systems enable faster service rollouts, better customer personalization, and improved scalability. The modular approach, driven by microservices and APIs, supports independent development and deployment, thereby enhancing innovation and reducing time-to-market. However, the research also revealed notable implementation challenges, including legacy integration issues, governance complexity, security risks, and workforce readiness. Case examples from Infosys, Flipkart, and HDFC Bank illustrated how strategic planning, robust training, and modern DevOps tools are essential for overcoming these barriers. Furthermore, the positive impact on business performance such as improved customer engagement, cost efficiency, and operational speed was consistently observed across various sectors. Overall, composable architecture is not only a technological upgrade but a strategic shift enabling enterprises to remain competitive, agile, and innovative in rapidly evolving markets. The findings validate its long-term value and strategic necessity in modern enterprise transformation.

References

- [1] Al-Saqqa, S., Sawalha, S. and AbdelNabi, H., 2020. Agile software development: Methodologies and trends. *International Journal of Interactive Mobile Technologies*, 14(11).
- [2] Behrendt, A., De Boer, E., Kasah, T., Koerber, B., Mohr, N. and Richter, G., 2021. Leveraging Industrial IoT and advanced technologies for digital transformation. *McKinsey & Company*, pp.1-75.
- [3] Biswas, S., Carson, B., Chung, V., Singh, S. and Thomas, R., 2020. AI-bank of the future: Can banks meet the AI challenge. *New York: McKinsey & Company*.
- [4] Chin, M.H., Kee, D.M.H., Kong, R.Y., Lee, J.Y., Yee, J.H., Bhardwaj, S., Chaudhary, P. and Pandey, R., 2020. The impact of global trends on organization and customer satisfaction. *Asia Pacific Journal of Management and Education*, 3(2), pp.109-120.
- [5] Darapaneni, N., Tanndalam, A., Gupta, M., Taneja, N., Purushothaman, P., Eswar, S., Paduri, A.R. and Arichandrapandian, T., 2022. Banana Sub-Family Classification and Quality Prediction using Computer Vision. *arXiv preprint arXiv:2204.02581*.
- [6] Derleth, T., 2018. Corporate Component and Service Libraries—A concept for creating, maintaining and managing a company-specific user interface component library in the field of frontend web development. *Derleth Thomas–Stuttgart*.
- [7] Dhuru, P., Makhijani, S. and Shetty, S., 2019. Study on Good Governance Practice in FMCG Sector'. *Pacific Business Review International*, 11(10).
- [8] Gissey, G.C., Zakeri, B., Dodds, P.E. and Subkhankulova, D., 2021. Evaluating consumer investments in distributed energy technologies. *Energy Policy*, 149, p.112008.
- [9] Gupta, S. and Das, S., 2020. Changing Payment Landscape in India. In *E-Commerce in India: Economic and Legal Perspectives* (pp. 204-221). SAGE Publications Pvt. Ltd.
- [10] Herger, L.M., El Maghraoui, K., Chung, I.H., Choudary, C., Tran, K. and Deshane, T., 2021, September. Toward an enterprise-ready composable infrastructure as a service. In *2021 IEEE International Conference on Services Computing (SCC)* (pp. 116-125). IEEE.
- [11] Kaur, G. and Dhiman, B., 2021. Agricultural commodities and FMCG stock prices in India: Evidence from the ARDL bound test and the Toda and Yamamoto causality analysis. *Global Business Review*, 22(5), pp.1190-1201.
- [12] KPMG, 2022. *Big shifts, small steps* Accessed from <https://assets.kpmg.com/content/dam/kpmg/se/pdf/komm/2022/Global-Survey-of-Sustainability-Reporting-2022.pdf>
- [13] Mehta, A.R. and Vijayakumar, S., DevOps in 2020: Navigating the Modern Software Landscape. *International Journal of Enhanced Research in Management & Computer Applications* ISSN, pp.2319-7471.
- [14] Mergener, A. and Maier, T., 2019. Immigrants' chances of being hired at times of skill shortages: results from a factorial survey experiment among German employers. *Journal of International Migration and Integration*, 20, pp.155-177.
- [15] Nadhamuni, S., John, O., Kulkarni, M., Nanda, E., Venkatraman, S., Varma, D., Balsari, S., Gudi, N., Samantaray, S., Reddy, H. and Sheel, V., 2021. Driving digital transformation of comprehensive primary health services at scale in India: an

enterprise architecture framework. *BMJ Global Health*, 6(Suppl 5), p.e005242.

- [16] Precedenceresearch, 2020. *Composable Applications Market Size, Share, and Trends 2025 to 2034* Accessed from <https://www.precedenceresearch.com/composable-applications-market>
- [17] Ray, K. and Sharma, M., 2020. Qualitative study of challenges and strategies of Indian IT organizations toward global branding. *Benchmarking: An International Journal*, 27(2), pp.708-731.
- [18] Roggeveen, A.L. and Sethuraman, R., 2020. Customer-interfacing retail technologies in 2020 & beyond: An integrative framework and research directions. *Journal of retailing*, 96(3), pp.299-309.
- [19] Sood, D., Sharma, K. and Sharma, S., 2020. Conduct Of Youth In Connection With Online and Offline Shopping: A Relative View.
- [20] Yaman, S.G., Munezero, M., Münch, J., Fagerholm, F., Syd, O., Aaltola, M., Palmu, C. and Männistö, T., 2017. Introducing continuous experimentation in large software-intensive product and service organisations. *Journal of Systems and Software*, 133, pp.195-211.

