On-Demand Quality Management for Service-Oriented Architecture Initiative: A Conceptual Study

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ABSTRACT

In the real world, service-oriented architecture (SOA) is a part-technology and part-business venture. Both parts play an important role in making SOA initiatives a reality for organisations to become SOA-enabled. The incorporation of technology and business is to respond to the needs of agile organisations and increase technological advancement. Organisations implementing SOA initiatives are able to architect business processes, functions and structures with recent technology enhancement specifically in services and composite applications. A comprehensive literature review on the SOA initiative has evolved significantly over recent decades, highlighting that while SOA effectively transforms organisational operations by aligning technology and business, there are documented failures in the implementation of SOA initiatives. The focus on this issue needs to be addressed despite a few studies found in the literature, both in the academic and business areas, covering the SOA initiative. The failure of SOA initiatives is attributed to the use of low-quality information (IQ) and the lack of verification through appropriate IQ management systems. These findings culminated in the formulation of a conceptual framework that combines SOA initiative with IQ management, shedding light on experiences among SOA team members. It shows a clear necessity to establish further work on case studies as well as in the comparative analysis to comprehend the implications of the results obtained. In this context, it is crucial that SOA initiatives with managing IQ will enhance organisational performance throughout the entire implementation of the SOA initiative.

Keywords: Service-Oriented Architecture, SOA, Quality Management, Information Quality, SOA Initiative

INTRODUCTION

Service-oriented architecture (SOA) has become a well-known acronym in the modern business and technology world as year-on-year leading vendors of SOA proved its worth in any industry. This is achieved by creating a business environment that quickly adapts and is responsive to business needs and constantly changing demands [1]. It has emerged as an architectural approach that is acceptable for organisations' business to be architected. This has ultimately changed how organisations perform worldwide in much the same way as their technology [2]. The primary advantage of SOA compared to traditional and conventional technology-based business processes is its ability to create services and composite applications that align with the requirements of agile organisations, focusing on what is beneficial for the business [3].

Although some organisations benefit more from SOA architectural style, other organisations do not [4]. Many studies have listed the factors that led to SOA's success. However, there are studies that have reported failures related to SOA. This is due to the fact that not because SOA did not realise its potential value but the readiness level within the organisation itself has not yet been established for implementing SOA initiative [5]. One of the reasons why SOA projects failed is that quality management was not in place [6]. While the quality approach has been considered in SOA systems, the discussion remains predominantly technical and no studies have investigated quality management in practice throughout the implementation of SOA initiative. An important to note that the phrase SOA adoption is frequently used interchangeably with SOA initiative.

World-wide Service-Oriented Architecture

The buzzword for service-oriented architecture is SOA. Regardless of being a tech buzzword or biz buzzword, beyond this would offer an innovative approach and excellence in the ever-changing world of technology and business – a pathway to progress. Web-enabling and connectivity facilitate this process, especially for enterprise integration that incorporates business services, enterprise services, application services and infrastructure services as well as their respective ownership teams (see Fig. 1) [7]. In realising this SOA, it is important to understand the essence of SOA and how organisations pursue the effort to become SOA-enabled.
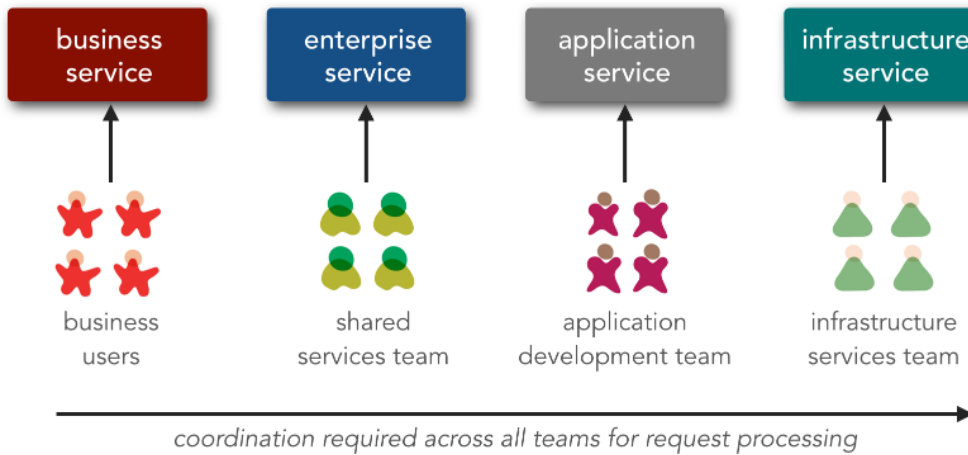

Fig. 1: SOA Technology and Business – *adopted from [7]*

Service-Oriented Architecture (SOA)

Defining SOA is not easy as one may describe it as a technology-enabling business [8] while another looks to SOA as a means to align technology with business [9]. The challenge of answering what is SOA has actually become imperative for many organisations to ensure a clear comprehension of its meaning. SOA may be delineated from two perspectives: the industry perspective and the academic perspective (see Table I). This means that both industrial and academic perspectives are covered to effectively implement SOA initiative which complements technology and business.

Table I SOA Definition – industry and academic perspectives

INDUSTRY	ACADEMIC
Gartner report – SOA is 'an architectural approach to building systems' [10].	SOA as 'an architectural style where systems consist of service users and service providers' [12].
Forrester report – SOA is 'a style of design, deployment, and management of software infrastructure and applications' [11].	SOA as a paradigm for structuring the business of an enterprise in the form of services which accordingly drives the IT architecture [13].

The implementation of an SOA initiative in an organisation would change the whole how business is run from within a single large-scale system to become a unified system across departments. This means that SOA transforms organisations from the traditional style in which applications and systems run dependent on business functions to the modern style in which composite applications and systems reuse business services (see Fig. 2) [14]. The importance of SOA is due to its benefits of usage:

- *to create reusable code* – not to reinvent but reuse available services,

- *to promote interaction* – services are shared through a central platform,

- *for scalability* – business changes but can scale to meet the client needs,

- *to reduce costs* – limit the amount of analysis needed to maintain a desired output.
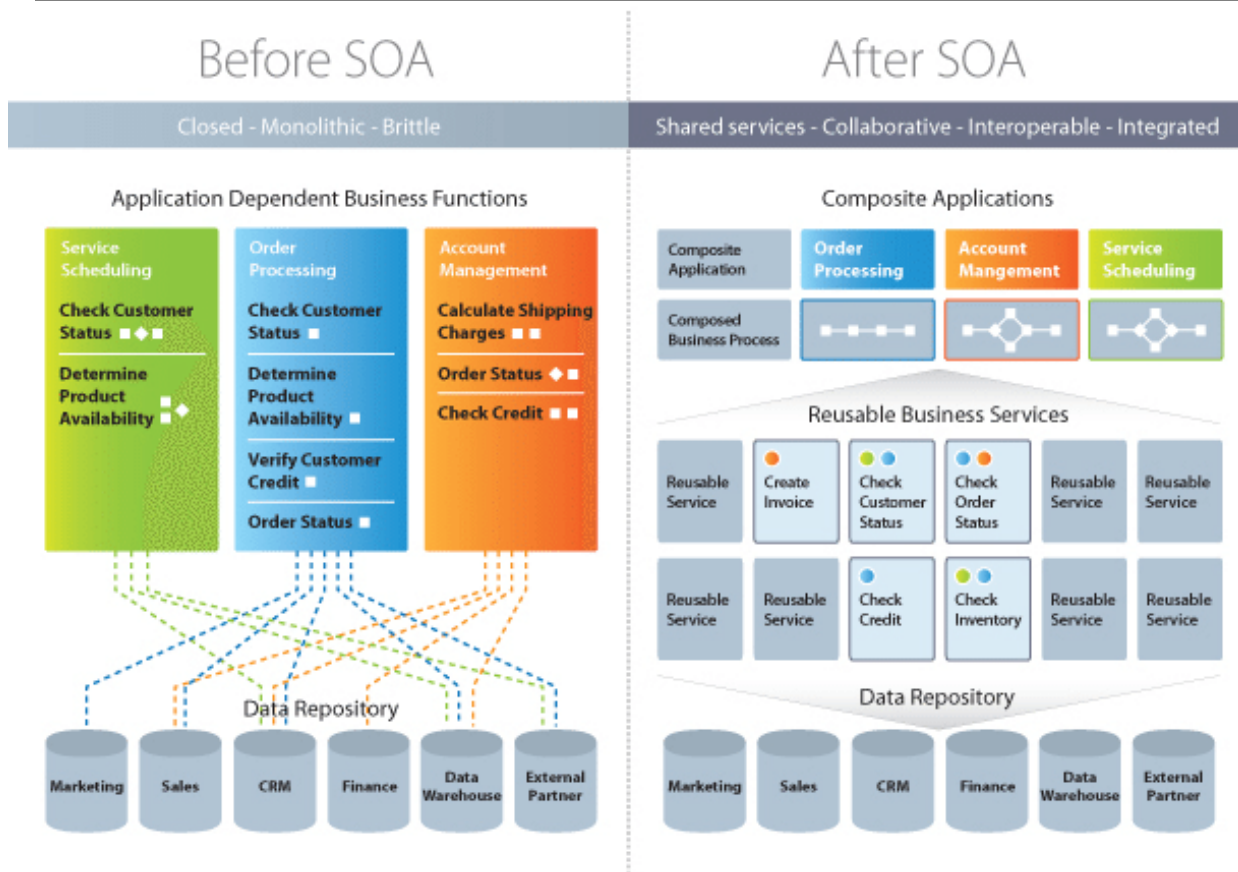
Fig. 2: SOA Before and After – *adopted from [14]*

It is important to take note that SOA remains a recognised term, but due to the concepts it introduced having evolved and integrated into newer architectural styles and approaches; it is often used interchangeably as microservices architecture [15] and API-led connectivity [16], [17]. This is because these modern terms build on SOA's foundational concepts which emphasizing reusability, interoperability, and loose coupling, but with a focus on more granular services and modern technologies.

Service-Oriented Architecture (SOA) Initiative

Scholars who study the adoption of SOA in organisations stated that SOA is a paradigm or a way of thinking or designing information systems that leads towards complete enterprise architecture [18]. This definition seems suitable to represent SOA for organisations that need to become SOA-enabled. Organisations that follow generic phases to deliver SOA initiative often achieve better return on information technology (IT) investment [5]. It is noteworthy that in order to increase significance of the review result, a greater variety of SOA providers is covered. In Table II, five (5) listed established SOA providers are Oracle and IBM as industry players, Gartner represents a neutral platform, and the remaining two (2) represent academic viewpoints. Upon thorough analysis and comparison, these SOA providers demonstrate excellent integrity and consistency in their processes, leading to the derivation of four general phases. These phases are:

1) *Strategic Planning*: Starting point of an organisation to plan strategically its SOA initiative implementation.

2) *Architecture Building*: Designing and developing SOA services and infrastructure to integrate with existing operational platforms.

3) *Services Operation*: All developed services are being exposed to allow integration with other systems and services.

4) *Continuous Improvement*: SOA is at the point of improvement either changing current services or creating new services to accommodate business change.

Table II SOA Initiative Process

SOA PROVIDERS	SOA PROCESS
Oracle's Approach to SOA [19]	1. Establish a strategic plan for SOA adoption; 2. Execute the SOA program level activities; 3. Deliver projects and Services following SOA best practices; 4. Establish ongoing guidance & gov.
IBM Scope of SOA Adoption [20]	1. Ad hoc stage; 2. Technology adoption stage; 3. Line of business adoption stage; 4. Enterprise adoption stage; 5. Value net adoption stage
Gartner Application Activity Cycle for SOA [21]	1. Strategies: SOA adoption considerations; 2. Evaluate: Planning and designing SOA systems; 3. Execute: Implementing and managing SOA in the real world; 4. Review: Improving and refining the use of SOA; 5. Innovate
SOA Roadmapping [22]	1. Planning & Analysis; 2. Design & Construction 3. Deployment & Operations; 4. Management & Gov.
SOA Adoption Management Roadmap [23]	1. Set strategy organisation; 2. Planning Strategy; 3. Organisation and Business; 4. Operations Planning; 5. Design; 6. Implementation; 7. Monitoring and Testing; 8. Establishment and Feedback.

Information Quality

An increasing volume of organisational data is produced and utilised for operating modern enterprises, both for completing transactions and supporting decision-making [24]. However, having more data and information, without concern for its quality, may create problems which often cause failure in businesses. The phrases "data quality" and "information quality" are frequently used interchangeably in the literature as poor data quality leads to inaccurate information and diminished business performance. Consequently, this will expand the area of data and information quality field of study in a broader perspective [25]. It is critical therefore to understand information quality, its dimensions and existing frameworks for specific contexts.

IQ Dimension

In the literature, IQ is viewed as a multi-dimensional concept and may be viewed differently in various contexts [25], [26]. This is because organisations have different quality requirements to determine the most suitable IQ dimensions. Thus, this can sustain the quality of information according to their businesses and their processes. Based on the literature, the most commonly used IQ dimensions are timeliness, accuracy, completeness, and consistency [27], [28] (see Table III).

Table III Most Common IQ Dimensions

Timeliness	The extent to which the information is sufficiently up to date for the task at hand.
Accuracy	The extent to which data are correct, reliable and certified free of error.
Completeness	The extent to which information is not missing and is of sufficient breadth and depth for the task at hand.
Consistency	The extent to which information is presented in the same format and compatible with previous data.

IQ Framework

Indeed, IQ is context-dependent in which the information used fits in one context but does not fit in another context [25]. It is critical for the success of such initiatives to understand how organisations manage and approach the quality of information [29]. With a framework that serves as a reference offers a comprehensive overview of the implementation process for the SOA initiatives and a practical guide to IQ that aligns business objectives and outcomes. Implementing this framework can facilitate practitioners expediting problem-solving [30]. There are four (4) goals that IQ frameworks should achieve [31]:

- a systematic and concise set of criteria by which the data can be evaluated,

- a scheme to analyse and solve IQ problems,

- the basis for IQ measurement and proactive management,

- a conceptual map that could be used to structure various approaches, theories and IQ related phenomena.

Quality Management for SOA Initiative

Previous sections have described the importance of SOA in facilitating business adaptability and ensuring organisational sustainability amid current competitiveness, as well as how IQ is set to guarantee quality throughout business operations. In an SOA setting, researchers can examine IQ in two ways; firstly, organisations that implemented SOA can improve IQ in the information exchanged across services [1] and secondly, with IQ management, SOA can be successfully implemented within organisations [6]. The term IQ means the fitness of information for an intended use, which in this context, is the relevant information suitable for initiating SOA initiative and implementing related services across the entire organisation [2], [29].

Table IV Recent Quality Approach in SOA Context

CONTEXT	QUALITY APPROACH	IQ ASPECT	STUDY
Development	Quality assurance	Agile services	[1]
Operation	Information quality management	Enterprise data	[6]
Architecture	Quality of service in measuring homogeneous services performance.	Service Meta-Store – a middle layer in large scale SOA	[29]
Integration	Quality service	Business processes and services	[33]

This clearly shows that IQ can be extended to SOA initiative for any organisation to consider its dimensions or criteria. Having many IQ dimensions to adopt can be complicated, but relatively few dimensions are worthwhile [32]. A number of studies that apply various quality approaches in diverse SOA contexts have been identified, and the latest studies are presented in Table IV.

Despite several research studies published in recent years, there is still a lack of authoritative works offering comprehensive coverage of the SOA initiative process available to organisations. In particular, there is a very limited amount of research thoroughly explores the full range of IQ throughout the entire implementation of SOA initiative. While quality approach has been considered in SOA, the discussion remains at a very high level. Five (5) aspects of SOA initiatives for quality management to foster [1]–[6], [9], [13], [29], [33].

1) *Management & Strategy*: Starting an SOA initiative requires full support from the top management with the appropriate strategy, mainly involving IQ. The organisation should realise and pay particular attention to IQ.

2) *Standards & Policies*: The key to success in implementing the SOA initiative is having IQ programs that focus not just on the data and information within SOA services but also on the standards and policies involved.

3) *Relationship & Communication*: The SOA initiative should ensure that the business gains long-term viability and acceptable quality in maintaining good relationships and effective communication.

4) *Design & Implementation*: SOA services that are designed, implemented and integrated with legacy systems within the organisation require IQ requirements and specification.

5) *Change & Performance*: Organisations need to focus on IQ tools to manage business changes and maintain SOA services throughout the business operation for the continuity performance of SOA initiative.

Since SOA is information management-oriented, there is a need to understand quality issues in relation to IQ dimensions and criteria. The relationship between quality attributes and SOA initiative process is therefore needed for this research to examine all necessary requirements for an SOA initiative.

CONCLUSION & FURTHER WORK

To conclude, SOA initiatives indicate that organisations are keen in adopt SOA for its long-term benefits which include to not only they quickly adjust to changing business requirements but also easily scale their systems with reusable services as needed. Various organisations in their respective industries have recognised that aligning technology and business will provide the greater value necessary for sustaining and thriving in their business pursuits. This creates a demand for quality management with necessary IQ aspects for organisations aspiring to become SOA-enabled. Thus, further work is required to bring this SOA initiative and IQ management into case studies via interviews focusing on IQ related issues that emerged at each SOA initiative phase. Next, these issues will be analysed to derive a set of IQ criteria and its associated dimensions. A comprehensive framework that acts as a mechanism for organisations to accomplish SOA initiative with quality management should be introduced.

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