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# Using Service Oriented Computing for Competitive Advantage

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## ABSTRACT

Research literature in strategic management indicates that firms may gain a competitive advantage in rapidly changing market environments by concentrating on their dynamic capabilities – i.e., product flexibility and agility in organizational transformation in response to rapidly changing market conditions and customer requirements. Service-oriented computing (SOC) has emerged as an architectural approach to flexibility and agility, not just in systems development but also in business process management. There is, however, a lack of critical research assessing the strategic impact of SOA on the competitiveness of organizations. The intent of this paper is to empirically examine the conduits through which service-oriented architectures (SOAs) may exert influence on dynamic capabilities within firms. The results could potentially assist in evaluating if and how the adoption of service-oriented architecture may help achieve key dynamic capabilities, giving the enterprise a competitive edge.

## Keywords

Service Oriented, SOA, SOC, Dynamic Capabilities, Competitive Strategy.

## INTRODUCTION

Recent cross-industry surveys of global CEOs (CapGemini 2007; IBM-BCS 2008) indicate that organizational agility is high on the priority list of business executives looking to establish a competitive advantage. The organizational processes that facilitate this kind of agility are termed “dynamic capabilities” (Teece and Pisano 1994) in management literature. In practical terms, there are five dimensions of dynamic capabilities: integration of internal resources, integration of external resources (partners, customers, etc.), rapid product development, learning, and the creation of assets. The ability to use these dynamic capabilities to rapidly build new resource configurations can result in sustained competitive advantage (Eisenhardt and Martin 2000).

The challenge then lies in implementing the organization’s business processes with information technology solutions that can facilitate these dynamic capabilities thereby building agility (Sambamurthy et al. 2003). IT infrastructures based on Service Oriented Computing (SOC) principles can provide organizational agility and, consequently, be a source of competitive advantage (Erl 2005). The SOC paradigm views whole business functions (order placement, for example) as modular, standards-based software services. The associated Service Oriented Architecture (SOA) establishes a defined relationship between such services offering discrete business functions and the consumers of these services, independent of the underlying technology implementation.

There is a great deal of enthusiasm in the industry about this concept (DSJ 2008), but the adoption of SOA by end-user organizations is still in a relatively early stage and there is little critical research on the practical use of SOA. There is, hence, a great dependency on analyst reports and vendor surveys for insights into the strategic value of implementing SOA. Some notable analytical literature does exist on the potential strategic value of Web Services and other empirical studies of Web services, and more generally SOA, are emerging. Nonetheless, there continues to be a need for further empirical investigation of the potential of SOA to provide organizations with a competitive advantage.

This paper empirically tests a prior study analytically linking SOA to dynamic capabilities (Luthria et al. 2007) using rich qualitative data gathered across fifteen firms. The paper examines how SOA is being used in practice to achieve the five dynamic capabilities - (1) integration of internal resources, (2) integration with of external resources, (3) rapid product development, (4) learning, and (5) creation of assets.

## SERVICE ORIENTED COMPUTING

A service is a business function implemented in software, wrapped with a formal, documented interface that is well known, does not depend on the internal workings of other services, and can be located and accessed by any software agent using standards-based communication mechanisms (Papazoglou 2003). These services could be simple services performing basic granular functions such as order tracking or composite services that assemble simple or other composite services to accomplish a broader modular business task such as a specialized product billing application. As an example, a business flow, such as an online book retail service, could be built using services across multiple service providers pulling together, say, billing services from a partner, and warehousing services from another partner. At a lower level, this could also potentially work for an individual business application say, the ordering of a book being built from tying together simple services such as a book search feature and customer verification.

While services manifest business functionality in the service-based computing model, a Service-Oriented Architecture (SOA) provides a framework for the infrastructure to facilitate the interactions and communications between services (Papazoglou 2003). An SOA is as an interconnected set of services which in its basic form is a message-based interaction between software agents, each accessible through standard interfaces and messaging protocols. These agents can be service providers or service requesters (clients) interacting with service discovery agencies, and the services in the SOA should be technology neutral, loosely coupled (not tightly integrated into the requester's process), and support location transparency.

Surveys of professionals worldwide indicate that knowledge and awareness of SOA amongst the IT professional community is "significant", with most companies "doing something related to SOA" (Quocirca 2005; Progress\_Actional 2006; DSJ 2008). The associated reports conclude that the spread of SOA is "almost inevitable". This mirrors the general optimism in trade journals and magazines, indicating that SOA, and specifically Web Services, is the popular choice for businesses looking for flexible systems development.

## DYNAMIC CAPABILITIES

Seminal work by Teece and Pisano (1994) in field of strategic management analyses the competencies or capabilities of firms that could result in potential competitive advantage. The concept of a firm's dynamic capabilities is introduced in this context of competition as those competencies or capabilities which facilitate the rapid creation of new products and processes by the agile coordination of "internal and external organizational skills, resources, and functional competences" in response to dynamic market conditions. In concrete terms, the following dynamic capabilities are identified to be potential sources of competitive advantage – (1) internal coordination and integration of business processes, (2) integration with strategic partners, (3) rapid product development, (4) learning by doing, and (5) creation or acquisition of assets (technological, complementary, financial, reputational, structural, institutional, and/or market assets).

Dynamic capabilities, as thus defined, appear to provide a suitable framework for looking at the potential strategic technology initiatives being pursued by corporations in the current market environment. In the much researched area of how information technology can be used to influence a firm's performance, an oft cited study theorizes that information technology can be used to enable key organizational capabilities and strategic processes, thus positively impacting the firm's performance (Sambamurthy et al. 2003). The authors indicate that their analysis is a stage-setter for potential future research, both analytical and empirical, in the bid to study the complex relationship of investments in information technology and organizational agility. Exploring this relationship further could provide additional insight into the strategic value of service oriented computing.

## THE EMPIRICAL STUDY

This study uses a case study methodology to investigate the research question. The applicability of the case study methodology to the study of the organizational impact of SOA is given credence by the study by Benbasat et al in their treatise on the use of case research strategy in information systems research (Benbasat et al. 1987). Benbasat *et al* argue that case study research may be used successfully in explorative studies, and the resulting generation of hypotheses is a legitimate vehicle to add to the body of IS knowledge. They believe that case studies are "well-suited to capturing the knowledge of practitioners and developing theories from it". They introduce the applicability of this research method to the IS field by citing how early studies of end-user computing resulted in management theories by descriptive studies of organizations, and arguing that the IS field is increasingly concerned with managerial and organizational questions, and hence the context of the usage. In their evaluation, Benbasat *et al* conclude that case studies can help analyse technology implementations and provide hypotheses about the impact of technology on organizations.

Accordingly, key decision makers at 15 (fifteen) firms – a mix of both financial service institutions in the banking and insurance sectors, and software service providers that had a significant number of clients in the financial services industry - were approached to understand their position on SOA. Most of these firms were chosen based on their involvement in industry conferences on SOA which was an indication of their interest in adopting SOA. A few, however, were chosen on an opportunistic basis leveraging a network of personal contacts. Table 1 describes the industry sector and profile of the firms interviewed as well as the designation of the interviewees.

Semi-structured interviews were conducted with business managers, enterprise architects, and CIOs/CTOs of 13 (thirteen) of these 15 firms. Communications with Firms 10 and 15 were conducted via email. A broad set of questions addressing specific areas of discussion (technology strategy, business drivers for the technology infrastructure, implementation details, challenges and concerns, benefits realized, and lessons learned) was used to guide all the interviews. The intended outcome of these interviews was to understand, among other SOA-related issues, what these firms and their clients considered to be their business drivers for adopting SOA and the actual benefits achieved. Wherever possible, the interview data was augmented by documents provided by the interviewees. Each of the individual interviews lasted an hour with the exception of the interview with Firm 5, which lasted 45 minutes.

Fourteen of the firms interviewed were in various stages of implementing SOA, either for themselves or their clients, most of them already having migrated targeted business functions to a service based deployment. The firms were able to provide some insight into the anticipated and observed benefits of the migration to a service-oriented approach. Firm 6 did not have an SOA strategy and had tried unsuccessfully to migrate to a service based infrastructure. The interview provided a valuable insight into the challenges of building a business case for SOA adoption. The product and software service providers were able to provide an insight not only into the business drivers for their product offerings but also their perception of the business drivers for their clients.

Transcripts of the individual interview data were analyzed using a two-phase thematic analysis method. The first phase of the analysis used inductive or open coding to identify key concepts. The second phase of analysis was performed using deductive coding, classifying the coded concepts into broader categories or themes including business drivers, implementation details, and realized benefits. The themes were then reviewed to identify similar patterns across the data from the multiple firms interviewed. Patterns relating to the business drivers and realized business benefits of SOA that impact the five dynamic capabilities were extracted from these themes across the fifteen firms.

Firm	Sector	Interviewee	Profile
1	Bank	Head of Strategy	Large Australasian private bank
2	Bank	Business development executive; Technical Architect	Large U.K. based bank
3	Bank	Business development executive	Large Europe based bank
4	Bank	CIO	India's second largest private bank
5	Bank	Enterprise Architect	Mid-sized Australasian public-sector bank
6	Bank	Enterprise Architect	Large Australasian private bank
7	Insurance	2 x Technology manager / Architect	Mid-sized Indian private general insurance firm
8	Insurance	CTO	Large Indian public sector general insurance firm
9	Insurance	CIO	Large Australasian insurance firm
10	Insurance	Enterprise Architect	Large Australasian public sector insurance firm
11	Product & Services	CTO; VP of Strategic Accounts	Small India-based ERP solutions firm
12	Product & Services	Technical architect	Large European ERP solutions firm
13	Product & Services	Technical architect	Large U.S. based software and services firm

14	Services	2 x Technical architect; Product manager	Large India-based software services and consulting firm
15	Services	Principal	Large US-based multi-national consulting firm

Table 1 - Summary of Firms Interviewed

### SOA AS AN ENABLER OF DYNAMIC CAPABILITIES

An earlier analytical study by the authors of this paper examine how the fundamental properties of an SOA-compliant architecture can help achieve the five dynamic capabilities – integration of internal resources, integration of external resources, rapid product development, learning, and creation of assets (Luthria et al. 2007). This study makes a case for the use of SOA as a possible means to an agile process and technology infrastructure, arguing that the key attributes of SOAs could help organizations achieve the five dynamic capabilities. This analysis is diagrammatically depicted in Figure1.

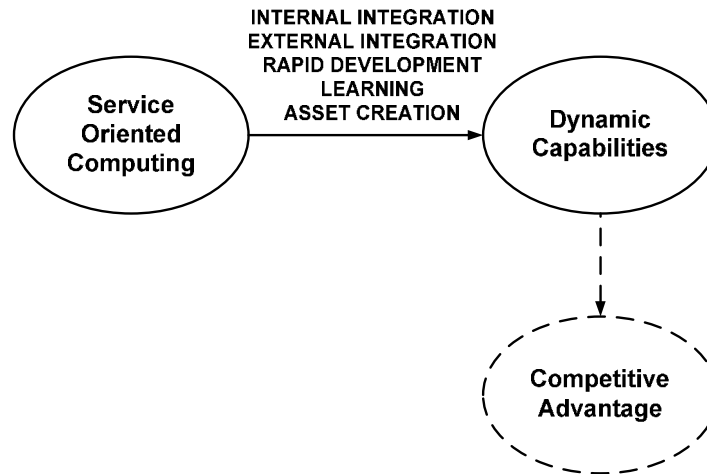


Figure 1 - Linking SOA to Competitive Advantage – Adapted from (Luthria et al. 2007)

The next 5 sub-sections consider this analysis in the context of the data collected from the fifteen firms, examining how these firms used SOA to achieve these capabilities.

### Integration of Internal Resources

Moving to a service based approach facilitates the intra-enterprise integration of diverse resources encapsulated as services on a standards based service delivery platform (Luthria et al. 2007).

The integration of internal systems was identified as a core business driver for SOA by Firms 2, 3, 4, 5, 6, 7, 8, 9, 12, and 14. Firms 4, 6, and 8 were still in the early stages of integrating their legacy systems, while service provider firms 12 and 14 had considerable experience using SOA principles to help their clients implement an integrated client access to back-end systems. Firm 14 indicated that the kinds of adoption they were seeing were moving from individual Web services to more of a platform paradigm, with their clients looking to deploy all their products or offerings through a single service platform. In order to achieve this, their clients were enhancing existing Enterprise Application Integration (EAI) frameworks to create an internal Enterprise Service Bus (ESB) to underpin the service-oriented architecture. Firm 7 was also using a similar approach building an ESB to provide orchestration or composition capabilities for the services, resulting in a unified customer view of their product offerings. Firm 2 was using its existing messaging backbone as an ESB to integrate its geographically diverse branch offices. Firms 2 and 5 had used service-oriented principles to integrate their back-end systems, and were looking to implementing a single customer view for their support center, while Firms 3 and 9 had started by creating an integrated front-end to provide a uniform customer experience across their diverse back-end systems – a faux integration of their back-end systems.

### Integration of External Resources

The transformation of an enterprise's business processes to services, along with standards-based communication protocols, potentially opens up new avenues of strategic partnerships with suppliers, partners, and customers (Hagel and Brown 2001).

Most other firms expressed skepticism that the integration with partners or new products would not be a customized effort each time. The Head of Strategy of Firm 1, one of Australia's top 4 banks, indicated that he was "suspicious of flexibility". The CIO of Firm 4, one of India's largest private sector banks, indicated that the ecosystem of partners was not ready for the flexible integration of partners. The CIO also cited security concerns and accountability concerns with service-based integrations. Each partner integration effort, according to the CIO of Firm 4, would for now continue to be a one-off project focused on the exchange of business data. Firms 2 and 8 were struggling with rationalizing the semantic nature of XML and the varying standards adopted by partners. Firm 6 which had just acquired another organization was struggling with the integration of the two enterprise systems, consequently continuing to function with two separate systems with minimal integration. Firm 14 also indicated that all their clients were not able to simply plug-and-play. The use of SOA for integrating external resources it appears, extrapolating from our data, needs the establishment of better standards and the availability of mature integration tools.

### Rapid Product Development

SOAs could potentially allow for rapid product development in that existing services implemented across varying platforms may be assembled to form new business applications (Bell 2007). This could potentially reduce the time to pull together well-design tested functionality to meet new market needs (Huang and Hu 2004).

Service providers, Firms 11 and 12 were able to leverage the portability of services across infrastructure to deliver service and products to clients running diverse platforms. Firm 7 was specifically able to showcase tangible benefits to the business team when they were able to port an insurance premium calculator from their web portal to a point-of-sale (POS) platform. They were able to reuse the core service to deliver the calculator function on the POS within 4 days as compared to 10 days for the original service. Firms 5 and 14 were able to identify common infrastructure requirements and implement them as services for reuse across various applications, thus reducing product development time.

### Learning

From a business process perspective, effective SOAs tend to be well-defined process-centric architectures, allowing for better process design and knowledge, monitoring, and rapid transformation of these processes from a business perspective rather than systems perspective (Channabasavaiah et al. 2004; Huang and Hu 2004). Firm 13 indicated that in their projects, process visibility up to the CTO level allowed for a better understanding of the process across the enterprise. Most other firms had not progressed to evolving their SOAs to the business process level, focusing on the technology infrastructure instead. As a result, it appears that there is minimal scope for learning at a business infrastructure level.

From a systems perspective, component modularity may contribute to the reduction over time of the learning curve of the development or assembly team due to familiarity with existing modular services (Channabasavaiah et al. 2004; Huang and Hu 2004; Huhns and Singh 2005). Firms 2, 5, 7, 9, and 11 indicated that it was difficult to create reusable services in practice. Although the CIO of Firm 9 felt using SOA increased IT value by making reusable and extensible, he indicated that the developers were "not crazy about reuse" and so end up re-creating services when needed for newer applications. Firm 5 felt one of the bigger problems with introducing SOA to the enterprise was the proliferation of services and the difficulty in the versioning of these services, while Firm 11 indicated that reuse was difficult because each customer invariably needed customization of the so-called common services. Learning by reuse, therefore, appears not to be feasible within the SOA context.

### Creation of Assets

The packaging of discrete business functions as services may provide new business opportunities for organizations in that, as time progresses, the developed services become a core asset of the organization – a library of tested, ready to use, compatible components (Channabasavaiah et al. 2004).

The possibility of offering up services to customers, both internal and external to the organization, was expressed by many of the firms we spoke with. In practice, however, there was some evidence of the use of common infrastructure services being reused across the organization, but a general consensus that the infrastructure and tools to support the external sharing of services was still not mature enough. Of the firms we interviewed, Firms 2, 5, and 7 indicated that they had been able to reuse some services across applications, but only to a limited extent.

## DISCUSSION

Examining the data collected across fifteen firms, this analysis attempts to understand if and how SOA can help realize the five dynamic capabilities in practice - the integration of internal resources, integration of external resources (partners, customers, etc.), rapid product development, learning, and the creation of assets. There appears to be some evidence to indicate that some of these dynamic capabilities are being realized more than others. This overall picture is described in the summarized in Table 2 using a heuristic rating scale of High, Medium, and Low - where High indicates strong evidence of the phenomenon, Medium indicates some instances of successes with no evidence to the contrary, and Low indicates no tangible evidence of the capability and strong indications of problems achieving the capability – and discussed in further detail in the following paragraphs.

A key business driver for the majority of the firms we spoke with was to integrate their back-end systems, and many were able to use service-oriented principles to integrate their internal resources – back-end or legacy systems. This is consistent with existing studies on the use of SOA for application integration (Baskerville et al. 2005; Legner and Heutschi 2007; Yoon and Carter 2007) that indicate that an SOA-based infrastructure facilitates easier application and enterprise system integration. The ability for SOA to achieve the integration of internal resources, it may be argued then, appears to be high. While the firms we interviewed were able to leverage SOA to create a delivery platform with an integrated view of their internal back-end systems, they had not integrated external systems into this platform.

The existing studies mentioned in the preceding paragraph indicate that the use of SOA eases partner and post-M&A integration. This use of SOA as an integration framework in the context of M&As is also examined by a recent study reviewing five companies across industry sectors which concludes that SOA can be used to effectively integrate disparate systems (Henningsson et al. 2007). Our data, contrary to these findings, appears to indicate significant challenges in the integration of external systems. Typical examples include Firm 2 which had managed to integrate their branch offices across various countries after significant challenges specifically with using Web services and XML as the integration platform. Firm 8, which was faced with the integration of two large enterprise systems after an M&A, had to settle for a non-standard integration in the form of screen scraping data from one system to be ported to the other! According to the Technical Architect – “Even normalizing one system gets hard. [The] format of messages coming and messages going out are prescribed. The time line is prescribed. But we are actually talking about different things, data semantics because implementation and doctoring over the years makes it two different systems”. Although the firms were using XML in their integration, it was not usable for a more generic integration because of the differing semantic interpretations of the data fields. This challenge was also noted in other recent studies detailing the challenges of adopting SOA and Web services (Ciganek et al. 2005; Luthria and Rabhi 2008). Our findings indicate that integrating partners using SOA could prove challenging because of the lack of industry standards and mature tool.

Dynamic Capability	SOA Correlation	Firms	Typical Quote (s)
Integration of internal resources	High	2, 3, 4, 5, 6, 7, 8, 9, 12, 14	Firm 2 – “The EBBS initiative to get a single view of all the services we offer [is a] service platform to provide single view of back-end systems (phase 1); Phase 2 will provide a single customer view to agents.”
Integration of external resources	Low	1, 2, 4, 6, 8, 14	Firm 8 – “You don’t see it until you see two businesses get together. They have the same legacy systems but they are different!”
Rapid product development	Medium	2, 5, 7, 11, 12, 14	Firm 7 – “Moving from one front-end to another was faster by 60%, for example, [we] deployed premium calculator service from portal to POS application in 4 days, down from 10 days for the original service.”
Learning	Low	2, 5, 7, 9, 11	Firm 9 – “SOA reuse can be a big problem. Our development team is not crazy about reuse.”
Creation of assets	Medium	2, 5, 7, 14	Firm 5 – “We (IT) act as a bridge. If there are common issues then we bring this back to the service layer.”

**Table 2 - Summary of Findings**

While service providers, Firms 11, 12, and 14, indicated that reusable and portable services reduced product deployment time, Firm 7 had actually benefited from the reuse of created services to develop new products rapidly. They were able to realize a savings of as much as 60% in the development effort of some products. Firm 2 indicated that it had seen the potential for reducing development time but had not been able to take advantage of these opportunities because of the inability to enforce reuse. Interestingly, Firm 5 indicated that while service reuse was actually low, the teams were nevertheless able to reduce the product development time because they created new services by applying minor modifications to existing services. Overall, the data appears to indicate that there appears to be the potential for and some realization of rapid product development using SOA.

There is little or no empirical research tying the use of SOA to organizational and/or individual learning. Reuse encourages familiarity with the services, thereby potentially enhancing learning. Our empirical data, however, indicates that reuse poses many challenges, some of which were ownership and accountability, security, performance, and sheer apathy for reuse. The lack of reuse, therefore, results in the proliferation of redundant services and re-creating of existing functionality. Arguably, this lack of reuse indicates a low correlation between the use of SOA and learning.

Although loosely coupled services could potentially be marketed as independent services, we found that only three of the fifteen firms had actually been able to achieve this, although only within the organization. Others were able to articulate this as a potential benefit but had not realized it for themselves. Firm 14 indicated that once ownership issues are resolved, infrastructure services could potentially be used across the organization, but they had not seen external sharing of common services. This was echoed by the CIO of Firm 4, who felt that there was definitely “a need for a large number of semi-public domain services for use” by the larger banking industry sector, but the general support ecosystem was not ready. According to this CIO, along with ownership issues, bank specific regulations precluded the dissemination and use of common shared services. Firms 9 and 11 indicated that the granularity of services was critical and they had been unable to find the right level of granularity to allow for their services to be used across multiple applications. The correlation of SOA with the creation of technological assets, therefore, has some merit according to the firms we interviewed, and there appears to be no data to refute this argument.

## CONCLUSION

The critical role of organizational strategy in gaining competitive advantage is reflected by investments in technology initiatives that are strategically important to firms’ core business (Swanson 1994). Little is known, however, of how SOA aligns with the strategy of the organizations adopting SOA. There is some academic literature relating to the potential strategic value of Web Services and SOA (Iyer et al. 2003; Lim and Wen 2003; Huang and Hu 2004) and other empirical studies are emerging (Baskerville et al. 2005; Moitra and Ganesh 2005; Henningsson et al. 2007). These studies use varying approaches to examine the impact of service-oriented computing on agility and, hence, competitive advantage. Even as these studies break new ground in the area of the strategic value and competitive advantage using Web services implementations, the links between SOA and competitive advantage remain largely unexplored given the relative infancy of the adoption curve of the SOA.

The strategic management concept of dynamic capabilities is a widely accepted approach to understanding the competitiveness of organizations. Few studies have linked service-oriented computing with the building of dynamic capabilities in management or information systems research literature. Those that have examined the strategic positioning of service-oriented computing have focused specifically on the impact of Web services on a single generic organizational capability such as application integration (Baskerville et al. 2005; Henningsson et al. 2007) or business process flexibility (Moitra and Ganesh 2005). There is no study that links SOA as a technology concept to the “first principles” of dynamic capabilities and the attributes of SOA that may make it amenable to creating dynamic capabilities and the channels through which it might be able to influence its creation are not well understood. This research attempts to address this gap by investigating the role of SOA in realizing dynamic capabilities which, as defined by Teece and Pisano (1994), could lead to the firm gaining a competitive advantage in the marketplace.

This study uses empirical interview data across fifteen firms to examine how SOA is being used in practice to achieve dynamic capabilities. The cross-firm data is examined to understand the firms’ experiences with integrating internal systems, integrating external systems (partners, customers, etc.), rapid product development, learning, and the creation of assets. This analysis is then used to extend the SOA-DC framework (Luthria et al. 2007), to understand how firms can use SOA for competitive advantage.



Firms deploying SOA initiatives were able to use the service concept to integrate their internal resources, and to a lesser extent to create services for use by other business units and for rapid product development. The use of services to integrate resources across organizational boundaries, however, is still a challenge since organizational contexts need to be semantically reconciled before service thinking can help. The other area where service orientation does not help is in increasing organizational learning. The lack of consistent reuse of services minimizes the opportunities for increased learning in organizations.

Although our dataset comprised fifteen firms, five of these were service providers who were able to give us an insight into how their clients were using SOA. According to these service providers, their clients spanning varied industry sectors had similar experiences using service oriented computing. While a potential extension of this study could include the direct investigation of firms in varying sector profiles, the similar patterns claimed to be observed by the service providers across their clients of diverse profiles helps bolster the argument relating the use of SOAs to the realization of dynamic capabilities. Consequently, this study could help practitioners prioritize organizational SOA initiatives with an understanding of how other firms are using service-oriented infrastructures.

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