How can Service-Oriented Architecture drive Service Innovation in newly emerging Service Systems?

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***Abstract*- Innovation in services can be regarded as an inter-play of service concepts, service delivery practices, client interfaces, and service delivery technologies. Furthermore, innovations in services are increasingly brought to the market by networks of firms, selected for their unique capabilities and operated in a coordinated manner, referred to as a service system or service value network (SVN). Bringing such service innovations to market by a network of firms requires extensive coordination and integration of data, information/knowledge and processes, while ensuring strategic alignment of partnering firms. In this research we examine how *Service-Oriented Architecture (SOA)*, and its effect on Information Technology Infrastructure Flexibility (ITIF), acts as an enabler for recently identified organizational drivers of services innovation in a service system, namely Collaborative Architecture Management (CAM) and Collaborative Organizational Infrastructure (COI).**

I. INTRODUCTION

In today's competitive environment, changes are taking place much faster than before [1],[2] as firms face intense rivalry, globalization, and time-to-market pressures [3],[4]. Securing a competitive advantage therefore does no longer rely on efficiency, quality, and customer responsiveness alone. While each of these factors is important, the requirement and ability to innovate, often with speed and value-added attributes, takes center stage. This makes innovation, flexibility, coordination, integration, and speed the new success factors of today's service value networks (SVN) [5]. Examples of services innovation operating in a SVN context include real estate portals, online universities, entertainment media tourism, interactive advertising, among others [6]. The development and delivery of new and elevated service offerings is contingent on the organizations' ability to anticipate and respond spontaneously to the changing needs of the market [7]. Information technology (IT) has been shown to play a critical role in enabling organizations to develop and deliver new and elevated service offerings [7},[8],[9], [10]. Furthermore, recent studies have identified two key organizational drivers for services innovation, defined as Elevated Service Offering (ESO) [3],[5], in a service system —Collaborative Architecture Management (CAM), reflecting coordination and alignment; and Collaborative Organizational Infrastructure (COI) that addresses the needs of integration [11]. Yet, the question on the technological options that are most appropriate to enable these organizational drivers, still remains to be answered.

Recently, Service Oriented Architecture (SOA) has been proposed as a mechanism to facilitate alignment of IT with business requirements that are changing at an ever increasing rate, because of its ability to engender a higher level of IT infrastructure flexibility (ITIF) [12]. It has been suggested that SOA can be used as an approach for building systems that enhance IT's ability to efficiently and effectively react to the fast-changing business environment and, in turn, enable organizations to respond to these changes in a timely manner [13],[14]. While the literature shows evidence of an association between SOA and ITIF, the potential role of ITIF within COI and CAM needs to be further examined empirically to investigate the linkage between SOA and eventual services innovation. This study will investigate such missing links by investigating how SOA infusion may work through COI and ITIF in enhancing CAM, leading eventually to services innovation or ESO. As such, the role of SOA as a technological option for enabling important drivers of services innovation in a service system will be firmly established. Next, we introduce the fundamental domains underlying the research question: SOA, ITIF, COI, CAM, and services innovation defined as Elevated Service Offering (ESO) [3],[6].

II. LITERATURE REVIEW

Service Oriented Architecture (SOA)

SOA represents a core technology in the increasingly important discipline of service science. This research employs the definition provided by [15], which adopts the view that "SOA is the architectural style that supports loosely coupled services to enable business flexibility in an interoperable, technology-agnostic manner. SOA consists of a composite set

of business-aligned services that support a flexible and dynamically re-configurable end-to-end business processes realization using interface-based service descriptions." Implicit in this definition is the objective of employing SOA to enhance Information Services (IS) and business agility [4], and to improve IT-business alignment in a rapidly changing business environment, cited to be crucial and yet extremely difficult to realize [16],[17],[18]. As such, those able to successfully implement SOA are able to realize greater IT infrastructure flexibility. Based on the proven association between SOA and ITIF, our research extends the important role of SOA by investigating its potential association with services innovation through enhanced COI and CAM.

IT Infrastructure

The literature suggests that IT infrastructure is the enabling foundation of shared IT capabilities and components upon which the entire business depends [19],[20],[21] and as a key source for attaining long-term competitive advantage. Overall, IT infrastructure is viewed as the shared fundamental resources that need to exist to attain competitive advantage, and is to be treated as a critical business capability, as well as a foundation of IT capability. IT infrastructure consists of both technical and human infrastructural components [20],[22]. However, it is often the technical IT infrastructure that is referred to when practitioners discuss IT infrastructure [23]. In this study, we also focus on the technical aspects of IT infrastructure.

IT Infrastructure Flexibility

IT Infrastructure Flexibility (ITIF) can be viewed as an organizational core competency [24],[21]. Some of the key dimensions of ITIF were proposed by [19]. Ref.[23] adapted Ref.[19]'s dimensions to further develop and propose three key constructs of ITIF – connectivity, compatibility, and modularity. *Connectivity* is the ability of any technology component to attach to any of the other technology components inside and outside the organizational environment. *Compatibility* refers to the ability to share any type of information across any technological components. *Modularity* addresses the ability to add, modify, and remove any software, hardware, or data components with ease and with no major overall effect. Our research will use Ref.[23]'s three dimensions of IT infrastructure flexibility.

COI and CAM

In SVN, decisions about technology deployment, IT systems integration and better integration of processes on an end-to-end basis can significantly impact organizational benefits. As such, technology adoptions, information sharing through systems, and process integration across partners of SVN are all essential criteria for success of SVN. *COI* is identified as a construct that allows for information and knowledge sharing through the integration of systems and processes both within and across organizational boundaries of SVN [11], facilitating the building of a sustainable service system that delivers services innovation. *CAM*, another organizational driver for successful services innovation, is defined "as an ability to co-ordinate and align resources, activities and routines that span across inter- and intra- organizations, with mutually agreed cost, revenue and risk sharing performance measures that are to the benefit all parties of SVN" [11],p.39. IT has the potential to act as a catalyst to promote and enhance the ability to collaboratively work with speed and flexibility.

Services innovation and ESO

Services innovation refers to a process of offering new services not previously available to the firm's customers [25]. In collaborative networks, however, ESO, a unique form of services innovation, is needed. ESO is defined as a new or enhanced service offering that can only eventuate as a result of a collaborative arrangement [3]. The service offering is "elevated" beyond what is possible by the individual firm through collaborative efforts and/or expertise of its network partners. Service innovation results when a firm is able to focus its entire energies to think on behalf of the customer for an outcome that surpasses customers' present expectation of superior value [26]p.24. In our context of network partners, previous alliance literature and innovation literature have demonstrated that innovation in services is possible in several dimensions through increased productivity, improvement in performance, and new service offerings [3],[8],[27],[28],[26],[29],[30],[31].

III. THEORETICAL UNDERPINNINGS AND HYPOTHESES

In this section, theoretical arguments for the research hypotheses are grounded based on extant literature on SOA, Resource Based View (RBV), the theory of dynamic capabilities, and service innovation. Following RBV and the theory of dynamic capabilities, we point out that the core value of IT infrastructure in SVN lies, in fact, on IT's capability of continued suitable blending, which can be realized through IT infrastructure flexibility. Next, our research postulates that the capability of continued suitable blending leads to better CAM with the help of enhanced COI through SOA infusion. Finally, the association between CAM and ESO is proposed.

SOA and Systems Integration

Previous studies suggest that SOA represents a technology paradigm to tackle the massive integration challenges occurring in alliances, mergers, and acquisitions, among many others [13]. Its core strengths lie in its ability to enhance proper integration, while promoting flexibility [32]. In addition to its ability to streamline internal business operations by providing an overlay that can allow disparate systems to communicate, it also enables more flexible integration with partners and offers organizations the ability to share applications and information that enhance the reach and richness of organizational integration [33],[34].

Both CAM and COI have been found as important organizational drivers for building a sustainable SVN [11].

CAM and COI encapsulate coordination, alignment and integration dimensions that integrate the design and underlying logistics of the SVN. Whereas CAM addresses coordination, conflict management, complementarity and compatibility, protection of assets, and collaborative alignment, COI addresses integrated systems and processes and integrated information sharing. Ref.[11] found that partner alignment, partner coordination, and partner integration emerged as the predominant underlying factors of CAM and COI.

Hence, SOA exhibits all the predominant features for enabling flexible integration with partners, and the ability to share applications and information that enhance the reach and richness of organizational integration. We therefore expect higher level of SOA infusion to enhance COI, an ability to integrate systems and processes across inter- and intra-organizational boundaries of SVN. We postulate the following.

Hypothesis 1: SOA infusion is positively associated with COI

IT Infrastructure as a Critical Resource: Resource Based View

Since Ref.[35]'s seminal paper, RBV has been widely adopted to define IT infrastructure in many studies [19],[21]. This literature stream suggests that IT infrastructure comprises the shared fundamental resources that need to exist to attain competitive advantage, and that it is a critical business capability. More recently, [36] proposed that IT resources (IT infrastructure was categorized as one of *inside-out* IT resources in their study) are increasingly emerging as sources of competitive advantage.

Because only valuable, rare, inimitable, and non-substitutable (VRIN) resources can lead to competitive advantages according to RBV, researchers have questioned what makes IT infrastructure (and IT resources generally) VRIN. Ref.[37] concluded from an extensive literature review of RBV-based IS studies that suitable blending of organization's various IT resources is the basis for developing competitive advantage. According to their study, suitable blending refers to the unique combination in which IT assets or resources are packaged and interwoven into business practices.

ITIF and Dynamic Environment: The Theory of Dynamic Capability

The notion of dynamic capabilities emerged as a response to the criticism leveled against RBV, namely, its inability to satisfactorily explain firm behavior and performance in dynamic environments. It is argued that RBV does not explain how and why certain firms have competitive advantages, especially during rapid and unpredictable changes. Ref.[38] defined dynamic capabilities as processes to integrate, reconfigure, gain and release resources to match, and even create, market change. Therefore, in order for IT infrastructure to qualify as a key resource from the perspective of dynamic capability, suitable blending at one point in time is not enough. Rather, it can be argued that suitable blending through continuous time frames is necessary. In sum, IT infrastructure flexibility, enabled by SOA initiatives, promotes dynamic capability of continued suitable blending. Accordingly, we postulate that:

Hypothesis 2: SOA is positively associated with ITIF.

This association between SOA and ITIF has already been shown in earlier research by [17],[16],[18] has been included for the sake of completeness, and will be validated as part of our research.

Toward better CAM

The dynamic capabilities of continued suitable blending allow firms to flexibly connect to other firms and rapidly incorporate their complementary capabilities in their SVN [39]. For instance, the key to developing supply chain (and SVN) coordination mechanisms are the dynamic capabilities resulting from flexibility of the enabling IT infrastructure [40]. Since SVN coordination relies mainly on CAM, which represents the ability to co-ordinate and align resources, activities, and routines that span both within and across organizations in a SVN, we postulate that:

Hypothesis 3: ITIF is positively associated with CAM.

Integration of IT systems and business processes allow transparency and a single, consistent view of information and material flow across boundaries. Access to timely and accurate information through systems and process integration provides collaborative agility to stakeholders – in the form of being able to quickly reposition, realign and maneuver resources, reconfigure assets, elevating the ability to co-ordinate and align resources across the service value chain [11]. Hence, the following is proposed for examination.

Hypothesis 4a: COI is positively associated with CAM.
Hypothesis 4b: COI is positively associated with ITIF.

What drives service innovation?

CAM, when supplemented by aligned goals and objectives of mutual risks and benefit sharing, leads to a win-win situation for all parties involved in the SVN. Furthermore, partner coordination involves close monitoring of managerial interaction, close communication for conflict resolution, and a clear governance structure for decision making.

In our context of SVN, information is a key to knowledge creation and diffusion, and above all, for decision making among service value chain partners. Decisions about technology deployment, Information and Communication Technologies (ICT) integration and better integration of processes on an end-to-end basis provide better transactional benefits. As such, technology adoption, information sharing through systems and process integration across partners

enabled by SOA infusion are expected to positively impact CAM, which through the arguments stated above helps drive the service innovation created by the network of partners. Hence, we postulate that:

Hypothesis 5: CAM is positively associated with ESO

Based on the foregoing brief discussions, the conceptual SOA infusion model is shown in Figure 1.

The research model depicts the five main constructs of this study: the infusion of SOA, ITIF, COI, CAM, and ESO, and the six hypotheses presented above.

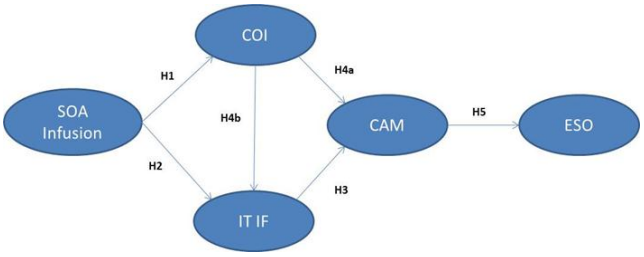

Figure 1: SOA Infusion Model

IV. RESEARCH DESIGN AND OPERATIONALIZATION

Research Design and Data Collection

A major telecommunication provider in the United Arab Emirates, its partnering organizations, and customer organizations will be targeted in the exploratory phase of the research. After appropriate pre-testing of the survey instrument with a pilot study, an online survey will be administered for the main study, to be administered to a service network, or set of networks, yet to be determined. The survey will have two target groups: on the one hand IT managers from each partnering firm with responsibility for responding to SOA, ITIF, and COI aspects; and on the other Service managers responding to CAM and ESO aspects – to ensure the selected respondents are truly key informants [41]. Subsequently, all constructs will be thoroughly tested for validity and reliability, and Structural Equation Modeling (SEM) analysis will be applied to analyze and validate paths in the model.

Operationalization of the constructs

The Infusion of SOA

SOA infusion is operationalized as a second-order construct, with *IT standards* and *IT architectural design* making up their first-order constructs [42],[32]. The current study adapts the four questions developed by [32] to assess IT standards. They ask the respondents to score the percentage of IT applications which use XML, WSDL, SOAP, and UDDI - the core standards of Web Services. The other first-order construct, IT architectural design, is measured based on the extent to which the organization conforms to the characteristics of SOA in their application [32]. For instance, the respondents are asked to evaluate the level of reusability, modularity, and interoperability among others in their IT applications.

ITIF

As noted, the dimensions of ITIF were proposed by [19] and further refined by [23] who developed the measurements for three dimensions in their study. ITIF measures are adapted from Ref.[23], reflecting *connectivity*, *modularity*, and *compatibility*.

COI

The scales for Collaborative Organizational Infrastructure (COI) were taken from [43]'s *systems orientation*, and *information sharing and dissemination* constructs, with further refinement by [11].

CAM

Earlier literature [44],[45],[46],[47],[48],[49] showed CAM to include the following dimensions: Coordination, Conflict Management, Complementarity and Compatibility, Protection of Assets, and Collaborative Alignment. These are essential managerial skills required to coordinate routines, tasks and activities, and to manage conflict amidst partners, partner fit and alignment in the context of strategic and operational objectives, mutual goals, capabilities, cultures, management styles, and the protection of proprietary assets. Ref.[11] empirically validated the CAM scale comprising of two dimensions, namely *partner alignment* and *partner coordination*; this scale is used.

ESO

Ref.[3],[6] have envisaged ESO as a higher-order construct comprising of multiple dimensions, including a new service offering, new organizational structure and service delivery mechanism, and productivity and performance improvements emerging as a result of collaboration. The *ESO-Strategic* component comprises strategic decision based elements, such as new or modified service offerings, new or modified customer interfaces, new service delivery processes and an expansion into new market segments and/or other industry sectors, arising as a result of collaboration with partners, something which was not possible on individual organizational merits. *ESO-Operational* is made up of a composite of two sub-constructs based on performance and productivity elements. The first aspect relates to *performance*, which includes facets related to service customization, utilization of assets, demand capacity, customer satisfaction and service reliability. The second dimension relates to *productivity*, which includes characteristics pertinent to lead time associated with commercialization of service offerings, service delivery lead times, on-time delivery of services and customer waiting time. Most of the constructs were adapted from extant literature with some minor modifications and additions [50],[51],[52],[53],[54],[55],[56],[57], which have been empirically validated by [3],[6]. Their measurement scale is used for this study.

IV. CONCLUSIONS

In today's competitive environment, frequent changes in services, suppliers, customers, and/or service delivery processes make the development and delivery of new and elevated service offerings critical. Our study will show eventually how IT infrastructure flexibility (ITIF) and Collaborative Organizational Infrastructure (COI), enabled by Service Oriented Architecture (SOA), may help firms operating in a Service Value Network (SVN) or Service System realize higher level of Collaborative Architecture Management (CAM), leading to services innovation or Elevated Service Offerings (ESO). Empirical validation of the proposed model will eventually provide practitioners with insights into how elevated service offerings can be enhanced with the infusion of SOA.

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