CRITICAL SUCCESS FACTORS IN THE MANAGEMENT OF A SERVICE-ORIENTED ARCHITECTURE (SOA) STRATEGY

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ABSTRACT

Service-Oriented Architecture (SOA) continues to achieve agility, efficiency and flexibility of core processes in business firms. The authors of the study analyze technical, procedural and business factors that contribute to effective management of SOA. Derived from an undergraduate research project survey and practitioner case studies of technology firms, the findings of the preliminary study disclose that business and procedural factors are more important in SOA strategy than functionality of technology, confirming earlier findings of the authors. The findings can help industry practitioners in confidently planning SOA strategy without confusion from the hype of technology firms. These findings as they are revised in a final study may be helpful to educators in information systems, as they consider further procedural and business emphasis of SOA and fruitfulness of research of SOA in information systems (IS) curriculum models that include IS 2006.

Keywords: Business Process Management (BPM), Information Systems (IS) Curriculum, Service-Oriented Architecture (SOA), Service-Oriented Computing (SOC), Service-Oriented Enterprise (SOE), Web Services

BACKGROUND

Service-Oriented Architecture (SOA) is a concept already defined in the practitioner literature:

> "[an enabling] framework for aligning business process and information technology (Mehta, Lee and Shah, 2006) by integrating processes and information technology infrastructure as [loosely coupled and] secure, standardized components [functions] – services – that can be [accessed by business departments or business units], combined, and reformed to address changing business priorities (Bieberstein, Bose, Fiammante, Jones and Shah, 2006) [of the units and of the business firm]".

Services deployed do discreet functions as component SOA services or a collection of functions as composite distributed services. They may be business services, as in the functions of processing a customer inquiry, or technical services, as in data warehousing, and services may integrate legacy infrastructures (Martin-Flatin and Lowe, 2007) interoperable with SOA in discoverable and publishable interfaces (Adams, Gisolfi, Snell and Varadan, 2002) for business departments. They may be flexible mash-up services in front-end interfaces to the back-ends of SOA that integrate business friendly Web 2.0 technologies (Taft, 2007). The goal of business firms in doing SOA is to be a Service-Oriented Enterprise (SOE) in integrating processes and services in larger intranet business unit-to-business unit and extranet firm-to-firm on-demand solutions.

Deployment of SOA is considered to be founded on business decisions of firms. Fundamental to the foundation is a business model that consists of the objectives and the core processes to achieve the objectives. Business enterprise architecture defines the design of detailed tasks of the business processes,

the business policies, as in management of metadata, and the information technologies included in an information technology infrastructure, based on the definition of what firms do as businesses (Lawler and Howell-Barber, 2007, p. 6). This infrastructure consists of the integration of applications, data bases, information, standards and platform technologies behind the processes. SOA consists of an enterprise architecture of services which is based on business objectives or a definition of business strategy.

Benefits of SOA continue to be cited in agility, efficiency and flexibility of business processes (Lawler and Howell-Barber, 2007, p. 4). Flexibility in processes as business models change because of competitor conditions, customer demands, global pressures, or even regulatory requirements can be beneficial to firms. The benefit of flexibility in both technical and business processes from plug and play interoperability of services and solutions of SOA can contribute exceptional functionality in the processes that may be considered by customers or partners to be better than or different from those of competitors. Time-to-market of new products may be an example of further benefits recognized by partners and customers (Koch, 2007). The benefits of services in an SOA can differentiate unique firm and customer propositions of value. These benefits of an SOA if not an SOE can differentiate business firms that desire discernable differentiation in their industry and are important to the firms (Information Week, 2008).

Because of the benefits and the importance of SOA, practitioner literature cites constant adoption of projects of SOA by business firms (Daniel, 2006 and Alter, 2007) that is confirmed by academic literature (Seethamraju, 2007). Currently 40% of projects are deployed as SOA in business firms (Amber Point Report, 2008).

Gartner forecasts 80% of projects to be based on SOA by 2008 (Gruman, 2006). IDC forecasts $15 billion to be invested by business firms in software of SOA by 2009 (Linthicum, 2007). Winter Green indicates $18 billion to be invested by business firms by 2012 (Hall, 2007). Clearly technology firms continue to market SOA to the business market (Tsai, Wei, Paul, Chung, Huang and Chen, 2007).

Business firms are challenged however in the dominant hype of technology firms marketing service and SOA solutions (Pieczkowski, 2007). Despite billion dollar investments, business firms in general have not benefited fully from services and SOA (Papazoglou and Van Den Heuvel, 2007). Literature in practitioner publications indicates that 70% of firms have met a few but not most of the benchmarks of SOA, and that 15% have met none of them (Babcock, 2007, September 17). Literature in practitioner publications further indicates only 5% of firms having met the benchmarks of an SOE (Retting, 2007, p. 7). Failure in expectations from the idea of services (Crosman, 2008, February 19) or of an SOE is not from frequent low benefit “low hanging fruit” homogeneous implementations of services at a department or a business unit level (Babcock, 2007, September 10). Failure is from infrequent high benefit heterogeneous high-throughput implementations and post-implementations of integrated services of SOA at a business firm level. The latter, forecasted to be implementations as late as 2013 (Crosman, 2008, February 11), lead to the real return-on-investment (ROI) of an SOE idealized by technology firms. Frustration is frequent in business firms filtering the hype of the technology firms so that they might control and manage projects of SOA (Bartholomew, 2007) on a path or a progression (LaJeunesse and Tzur, 2008) to an SOA. Literature in scholarly publications indicates implementation issues at business firm levels than project implementations at business unit low hanging fruit levels (Gallagher and Worrell, 2008). Methodology of managing SOA as a business strategy continues to be a concern for industry

managers and practitioners and for instructors in information systems that introduce SOA as a methodology to students.

INTRODUCTION TO STUDY

In this study, the authors analyze the methodology of managing SOA as a business strategy, based on earlier analyses of Web services and SOA (Anderson, Howell-Barber, Hill, Javed, Lawler and Li, 2005 & Lawler and Howell-Barber, 2007) conducted at business firms with industry practitioners of services and SOA. Findings from focus groups and surveys in the studies disclosed that business firms that lead projects in services or SOA with business considerations have more benefits in effectiveness from SOA than business firms that lead the projects with technical dimensions. Factors of business benefit driver, customer demand, and focus on integration of processes defined by business departments in the firms as examples have higher importance in managing SOA as a strategy than factors of platform technology of SOA defined by technology departments or technology firms. Methodology of SOA moreover has higher importance than the perceived technology of SOA. These findings are considered to be beneficial to manager practitioners in managing SOA as a business strategy.

Though the business dimensions of services found by the authors are defined by technology firms marketing SOA, projects of services and of SOA are done frequently from purely technical dimensions (Bell, deCesare, Iacovelli, Lycett and Merico, 2007) if not described in technical terminology of the technology firms (Dodds, 2008). Technology departments of business firms may focus moreover on services as low hanging fruit solutions than on an SOA strategy (Feig, 2007). They may not be even fully knowledgeable in the business strategy, which may not be shared by the business units of the business firms. The business departments and technology departments of the business firms may be limited by methodology that is not fast, flexible, incremental, innovative, nor iterative in release of services in an SOA strategy (Lawler and Howell-Barber, 2007, p. 16). To manage SOA as a business strategy, manager practitioners can benefit from a dynamic methodology that is focused more on business and procedural elements and less on the technical functionality of SOA.

The literature in services continues however in indicating a gap in further including procedural and business factors in the management of an SOA strategy (Marjanovic, 2004). Demand for including business enterprise goals into the technical strategy of projects (Cameron, 2007), such as those of SOA, is referenced in the literature. Is the infrastructure of the platform technology in the technical strategy integrating the practitioner strategic vision of the technology (Prahalad and Krishnan, 2002)? Management of SOA as a business strategy is imputed in this study to subordinate the technology hyped by the technology firms to the practitioner vision of the technology. To do this, manager practitioners and technologists have to be joined in learning a methodology new in strategizing SOA as a vision (Hurwitz, 2007) and in managing the technology firms to this vision (Rodier, 2008).

The methodology of managing SOA as business strategy, subordinating technology to the practitioner strategic vision of technology, is a discipline important in including in the curricula of information systems. The curriculum is developing students to be future practitioners and technologists of SOA in industry (Lim and Jong, 2006, p. 1). Though schools of information systems have initiated programs on SOA, they are frequently not including business process management (BPM) or methodology of SOA as a reengineering strategy. They may be integrating SOA as a technology, not as a methodology or a business strategy. They may be integrating non-agile methodologies, not hybrid non-agile and agile

methodologies of industry practices of SOA (Kohun, Wood and Laverty, 2007), so that students may not be learning the state-of-the-art of SOA.

The practices of industry on SOA may be input into the curriculum of information systems that might model the discipline of SOA (McAleer and Szakas, 2007, pp. 1-2). The importance of the methodology of SOA as a business strategy (Medjahed, Bouguettaya and Benatallah, 2007) is clear in the demand of industry for professionals experienced in the management of services and SOA and in procedural and process reengineering with SOA (Lee, Trauth and Farwell, 1995). The methodology of SOA as a business strategy, and not as a technical strategy, might inspire students in information systems and computer science to become practitioners of SOA (Lim and Jong, 2006, p. 2). Students might be more knowledgeable in the business, procedural and technical of SOA if instructors learned more of the program of SOA. They might be more marketable to industry if they learned business, procedural and technical facets in the management of SOA, factors of which are the focus of this study.

FOCUS OF STUDY

The focus of this study is to analyze factors that can contribute to effectiveness in the management of SOA as a strategy. The factors, consisting of business, procedural and technical in Table 1, are derived from in-depth analyses of industry programs and projects by the authors in earlier research of services (Anderson, Howell-Barber, Hill, Javed, Lawler and Li, 2005) and of SOA (Lawler and Howell-Barber, 2007, pp. 27-59) and are condensed from a disciplined methodology of managing SOA as a strategy (Lawler and Howell-Barber, 2007). These factors are also derived but filtered from the literature of technology firms and of business firms and from other industry literature. The goal of this study is to confirm the current importance or non-importance of business, procedural and technical factors individually and relatively to the management of an SOA strategy, in contrast to our earlier studies (Anderson, Howell-Barber, Hill, Javed, Lawler and Li, 2005 & Lawler and Howell-Barber, 2007). Few scholarly studies have examined the business and procedural factors of SOA in contrast to the technological factors and products often hyped by the technology firms. This study contributes findings that may be helpful to instructors in information systems in developing curricula on SOA and to practitioners investing in SOA as a strategy.

Table 1: Factors of Study

Factor Type	Description of Factor
Business Factors	
Agility, efficiency and flexibility benefits	Extent to which benefits of adjusting to business environments drive the program
Financial benefits	Extent to which benefits of increased revenues and / or decreased expenses drive the program
Business client participation	Extent to which business departments consent, contribute and furnish content and guidance to the program
Competitive, market and regulatory differentials	Extent to which competitive, market and regulatory first mover edge for the firm drives the program
Customer demand	Extent to which customer demand for enhanced service from technology drives the program
Culture of innovation	Extent to which innovation in business and technical practices is encouraged and facilitates the program

Organizational change management	Extent to which cultural change management is evident in helping business and technical staff embrace the program
Executive sponsorship	Extent to which senior managers in the firm articulate and evangelize the business criticality of SOA as a strategy and fund the program
Executive business leadership	Extent to which senior managers in the business units evangelize business criticality of SOA as a strategy
Executive technology leadership	Extent to which senior managers in the technology departments evangelize the technical and business criticality of SOA as a strategy
Strategic planning	Extent to which business strategy of SOA is articulated in the firm and is accepted by program staff
Enterprise architecture	Extent to which formal enterprise architecture contributes to initiation of the program and evolves with processes to an SOA
Focus on improvement of process	Extent to which improvement of business processes, process integration and service choreography are the goals of the program
Service orientation	Extent to which technical and business staff is receptive to principles of service orientation and SOA
Reusability of assets	Extent to which multiple services using software technologies is a goal of the program
Procedural Factors	
Control of program	Extent to which a formal function is evident for guiding and helping the firm in evolution to SOA
SOA center of competency	Extent to which a centralized team is evident for furnishing SOA expertise help to program staff
Responsibilities and roles	Extent to which responsibilities and roles of staff on the program are clearly defined for completing project tasks
Education and training	Extent to which formal skill training on services and SOA is evident for program staff
Knowledge exchange	Extent to which processes and procedures are evident for informing business and technical staff of progress of the program
Change management	Extent to which procedures are evident for ensuring optimal resolution of requests for changes in existing processes or services or of requests for new processes or services
Information management	Extent to which procedures are evident for ensuring data integrity and quality for technical and business functions
Common reference	Extent to which business and technical terminology is applied consistently by program staff
Naming conventions	Extent to which naming standards and service versioning are used by program staff
Procurement of technology	Extent to which a formal function is evident for furnishing quality hardware and software technology to the program in a cost effective and expeditious manner
Technology firm knowledge capture	Extent to which program staff captures knowledge from hardware and software technology firms in order to be independent of the firms
Risk management	Extent to which procedures are evident for mitigating failure or loss caused by SOA
Standards management	Extent to which program staff is cognizant of official standards, scope of implementation of the standards by technology firms and standard gap resolution techniques
Infrastructure architecture	Extent to which procedures are evident for guiding the evolution of technology in a strategy of SOA
Process and service deployment environment	Extent to which procedures are evident for furnishing software and tools to the development staff on the program
Process and service deployment techniques	Extent to which procedures are evident in order to ensure the highest quality of deployed technology throughout the program
Service catalog management	Extent to which procedures for managing a registry or a repository of processes and services are evident on the program
Service management and support	Extent to which procedures are evident for ensuring service availability and reusability and furnishing metrics on service support

Security management	Extent to which procedures are evident for safeguarding access to services
Continuous process improvement	Extent to which procedures are evident for iterative improvement of existing and new processes
Costing techniques	Extent to which techniques are evident for costing existing and future SOA product realization and support
Strategy management	Extent to which procedures are evident for evaluating and improving program strategy of SOA as required
Technical Factors	
Internal web services on project	Extent to which web services as simple projects contribute to the evolution of SOA
Internal process domain on project	Extent to which complex web services applications contribute to the evolution of SOA
Internal SOA domain on project	Extent to which standards compliant, internal and loosely coupled projects contribute to the evolution of SOA
External process domain on project	Extent to which external tightly coupled and security sensitive and trusted projects contribute to the evolution of SOA
External SOA domain on project	Extent to which external standards compliant, loosely coupled and security sensitive and trusted projects contribute to the evolution of SOA
Business process management software	Extent to which Web Services-Business Process Execution Language (WS-BPEL) software is included on the program
Data tools	Extent to which data tools supporting Extensible Markup Language (XML) are included on the program
Middleware	Extent to which an enterprise service bus (ESB) or traditional middleware technology is included on the program
Platform of key technology firms	Extent to which the platforms from key technology firms (e.g. BEA, IBM, and Microsoft) are included on the program
Platform specialty tools from platform technology firm	Extent to which specialty tools of the platform technology firms are included on the program
Proprietary technologies	Extent to which proprietary software is included on the program
Best-of-class tools	Extent to which specialty tools from pure play or third party technology firms are included on the program
XML standard	Extent to which XML is included on the program
Messaging standards	Extent to which technology supporting Simple Object Access Protocol (SOAP), SOAP Message Transmission Optimization Mechanism (MTOM) and SOAP with Attachments (SwA) or similar standards is included on the program
Service description and discovery standards	Extent to which technology supporting Universal Description, Discovery and Integration (UDDI), Web Services Description Language (WS-DL) and Web Services-Policy (WS-P) or similar standards is included on the program
Transaction standards	Extent to which technology supporting Web Services-Composite Application Framework (WS-CAF), Web Services-Choreography Description Language (WS-CDL) and Web Services-Transaction (WS-TX) or similar standards is included on the program
Security standards	Extent to which technology supporting Extensible Markup Language (XML) Encryption, XML Signature, Web Services-Federation (WS-F), Web Services-Security (WS-S) and WS-Security Policy (WS-SP) or similar standards is included on the program
User interface standards	Extent to which user interface tools or Web Services-Remote Portlets (WS-RP) are included on the program
Web services best practices	Extent to which Web Services-Interoperability (WS-I) is included on the program
Web services management standards	Extent to which Service Provisioning Markup Language (SPML) and Web Services-Distributed Management (WS-DM) are included on the program

Source: Lawler and Howell-Barber (2007), Service-Oriented Architecture: SOA Strategy, Methodology, and Technology, pp. 45-49.

These factors form the framework for the methodology of the study.

RESEARCH METHODOLOGY OF STUDY

"Undergraduate research is an inquiry or investigation conducted by an undergraduate [student] in collaboration with a faculty mentor that makes an original intellectual or creative contribution to the discipline" (Wenzel, 1997).

The research methodology of the study consisted of a top down literature survey of products of 21 technology firms that applied the products to programs of projects of SOA in business firms in 2007. Each of the 21 firms was chosen based on the apparent deployment of a diversity and maturity of complex, intermediate and simple internal and external projects of SOA that were on an apparent path to SOE because of the products. The survey was done from the literature of the technology firms but was filtered by other technology agnostic literature of leading consulting organizations. The survey evaluated the products applied to collective programs of projects based on business, procedural and technical factor importance in the implementation of the projects in 2007 in a perceived SOA strategy. The factors of the programs were evaluated on a seven-point scale of very high (7), high (6), somewhat high (5), low (4), somewhat low (3), very low (2), and not applicable (1) in importance. The survey was performed by a technology agnostic undergraduate student, in a *Service-Oriented Architecture (SOA) Strategy Independent Project Study*, at the Ivan G. Seidenberg School of Computer Science and Information Systems of Pace University, and the student was the second author of the study. The student performed the survey in the fall September 2007 – February 2008 semester.

(During the period of the survey, the student participated with the instructor of the Independent Project Study, also the principal author, at conferences and exhibitions in industry, including *SOA Executive Forum* and *SOA / Web Services on Wall Street*, lunch & learn seminars on SOA at the Seidenberg School, and SOA Webcasts by technology firms on SOA, which were requirements of the Study.)

Following the survey, the methodology of the study consisted of bottom up case studies of the products of 3 technology firms covered in the survey that similarly applied the products to programs of projects of SOA in the business firms in 2007. Each of the 3 technology firms were chosen based on highest deployment of the diversity and maturity of the projects of SOA of all of the 21 technology firms. The case studies evaluated the products applied to individual programs of projects based on business, procedural and technical factor importance in the implementation of the projects in 2007 in an SOA strategy and on the aforementioned seven-point scale of the survey. These programs of projects were evaluated in in-depth studies that as feasible included non-structured interactions at the business firms, in order to have filtered the hype of the technology firms. Internal documentation on processes was evaluated selectively at these firms. The case studies were performed by an experienced technology agnostic industry practitioner in process and services technologies. The practitioner performed the studies in relatively scholarly steps (Eisenhardt, 1989). The practitioner was the third author of this study. The case studies were performed in the spring February – May 2008 semester of the Study. The goal of the case studies was to confirm or not confirm the general findings from the literature survey.

(During the periods of the case studies and the literature survey, the student was mentored and the practitioner was supervised by the principal author.)

Finally, the methodology included statistical analysis of the findings from the case studies and the literature survey, which is being performed by the author of the study.

PRELIMINARY ANALYSIS – SURVEY OF 21 TECHNOLOGY FIRMS

(Descriptive and statistical interpretation of the findings from the survey of the technology firms is in progress.)

PRELIMINARY ANALYSIS – CASE STUDIES OF TECHNOLOGY FIRMS 1, 2 AND 3

The technology firms in Case Study 1, 2 and 3 are confidentially described as Firms 1, 2 and 3. These firms were deploying a commingled mix of products - application legacy adaption, business process management (BPM), configuration and deployment, data management, development, integration and service, knowledge management, management and monitoring, middleware and service bus, registry and repository, run time, security and testing tools - for programs of projects of SOA in Fortune 100 business firms in 2007. The products of these 3 technology firms were implemented largely in a mix of programs of internal business unit and firm process projects and external firm process projects that were the highest programs in intensity in SOA than the programs of the other 18 technology firms in the survey. The programs included 3 to 5 business firm projects for each of the 3 technology firms, and the benefits of the projects were indicated in the literature of the 3 technology firms to be business process improvement, conformance to regulatory changes, enhanced customer service, faster marketing of products and services, and increased industry market opportunity and share, mostly indistinguishable from the other firms in the survey. The descriptions of the Case Study technology firms are displayed in Table 2.

Table 2: Descriptive Summary of Case Study Technology Firms

Technology Firms	**Firm 1**	**Firm 2**	**Firm 3**
Business*	$90 Million	$100 Million	$40 Million
Products			
Application Legacy Adaptation	x	x	
Business Process Management	x	x	x
Configuration and Deployment	x	x	x
Data Management	x		x
Development, Integration and Service	x	x	x
Knowledge Management	x		
Management and Monitoring	x	x	x
Middleware and Service Bus	x		x
Registry and Repository	x	x	
Run Time	x		x
Security	x		
Testing	x	x	
Programs of Projects			
Internal Process	x	x	x
External Process	x	x	x

Benefits			
Business Process Improvement	x	x	x
Conformance to Regulatory Requirements	x	x	x
Enhanced Customer Service	x	x	x
Faster Marketing of Products and Services	x	x	x
Increased Market Opportunity and Share	x	x	x

*2007 Sales of SOA

The programs of projects in technology Firm 1 focused on external and internal process projects in the business firms in 2007. The programs were driven by business benefits of *agility, efficiency and flexibility, competitive, market and regulatory differentials, customer demand, finance,* and *focus on improvement of processes. Executive business leadership, executive sponsorship* and *executive technology leadership* in the business firms were factors highly important in the implementation of the programs. The technology firm implemented methodology for *change management, education and training, process and service delivery environment and deployment techniques,* and *service catalog management and support* by instituting *centers of competency for SOA.* However *technology firm knowledge capture* was constrained in the business firms, as technology Firm 1 continued to mostly manage the programs, hindering the business firms in becoming independent of Firm 1. *Platform technology* of the firm was an enabler in the implemented programs of Firm 1. The implementation of SOA in the programs of Firm 1 was impacted more by business factors than by procedural and technical factors in findings of success.

Firm 2 focused on programs of external and internal process projects as in technology Firm 1. Business benefits of *agility, efficiency and flexibility, competitive, market and regulatory differentials, customer demand, finance,* and *focus on improvement of processes* were equivalent in technology Firm 2 as in Firm 1. However *executive business leadership* and *executive sponsorship* were factors less important than *executive technology leadership* of the technology departments of the business firms in the implementation of the programs. *Culture of innovation* in the business firms was less important in the programs than in Firm 1 or Firm 3. Firm 2 implemented limited methodologies in lower *control of program,* in lower integrated *process and service delivery environment,* and in non-existent *responsibilities and roles* of staff in the business firms, though Firm 2 instituted *centers of competency for SOA* that included *service catalog management and service management and support*. *Technology firm knowledge capture* was nevertheless not constrained in the business firms of Firm 2, as in Firm 1 or 3. *Executive technology leadership* of the programs in the business firms was independent of technology Firm 2. *Platform technology* and *platform specialty tools* of Firm 2 were enablers facilitating implementation of the programs. The implementation of the programs of Firm 2 was impacted more by business factors than by procedural and technical factors, but they were not as notable as in Firm 1 in the findings of success.

Firm 3 was focused on programs of external and internal process projects of SOA as in technology Firms 2 and 1. Business benefits of *agility, efficiency and flexibility, competitive and regulatory differentials, customer demand, finance,* and *improvement of processes* were equivalent in Firm 3 as in Firms 2 and 1. *Executive business leadership* and *executive sponsorship* from the business units in the business firms as in Firm 2 were less important than *executive technology leadership* of the technology departments in the

initiation and installation of the programs. *Reusability of assets* and *strategic planning* in technology Firm 3 were less important in the programs than in Firms 2 or 1. Methodologies were lacking noticeably in *change management*, *control of program*, *responsibilities and roles* of staff, *service catalog management*, *standards management*, *strategy management*, and *technology firm knowledge capture* in the business firms. They were lacking in *centers of competency for SOA* highlighted in the programs in Firms 2 and 1, as the *centers of competencies* were limited to the products of Firm 3 and were not the neutral programs of Firms 2 and 1. Though the projects of the programs were enabled by *education and training* in the *platform product technology* and *specialty tools* of Firm 3, the methodologies of Firm 3 were less important than the methodologies of Firms 2 and 1 and less important than its technologies and tools, which the technology departments of the business firms depended upon Firm 3 for continued installation, but which the technology departments managed independently of the business departments. The implementation of SOA in the programs of Firm 3, in contrast to Firms 2 and 1, was impacted inevitably more by technical factors than by procedural or business factors in the findings of success.

Implementation of the programs of projects of SOA in technology Firms 1, 2 and 3 indicate that business factors were more important than procedural and technical factors in aggregate findings of success. Procedural factors were however less important than technical factors in aggregate findings of success. Firms 1 and 2 indicated that business factors were more important than procedural and technical factors, which were noticeably higher in Firm 1 than in Firms 2 and 3. Firm 3 indicated that technical factors were more important than procedural and business factors, the latter of which were noticeably higher than in Firms 2 and 1. Findings indicated that *business leadership* and *executive sponsorship* in the business units of the business firms were considerations impacting the higher or lesser importance of technical factors of the programs of these technology firms.

ANALYSIS SUMMARY

(Statistical interpretation of the findings from the case studies and the survey of the technology firms are in progress.)

PRELIMINARY IMPLICATIONS OF STUDY

Preliminary findings of business and procedural factors having higher importance than technical factors emphasize the implication of the importance of business leadership on programs of projects of information systems and SOA. Managers in business have to lead the programs of projects of information systems, so that the technology of SOA is not foremost to fundamental business models (Feld, 2007). Managers in the business firms, and in the technology units of the firms, frequently do not lead in business process improvement of business models (Shay, 2007), in innovation of technology, nor in integration of technology and business (Carter, 2008), though the literature in practitioner and scholarly sources indicates the necessity. The goal of managers has to be to enhance internal if not external processes relentlessly in the integration of SOA throughout the firms. Manager practitioners might be educated further on the business proposition of information systems (Rettig, 2007, p. 8) and SOA if not the technology, and instructors in information systems might begin to enhance in the interim the content of courses in the curricula in schools of information systems, so that students might be educated further in the interdependence of SOA and its proposition as a strategy.

Importance of improving the curricula in schools of information systems in the business proposition of SOA as a strategy is another preliminary implementation of the study. Literature indicates the complexity of design and the discomfort of instructors in improving courses in information systems, so that they are current with industry methods and practices of firms (Cameron, 2007). Though instructors may be in committees confronting continued and further evaluation of practices in industry, students in information systems may not in the interim be learning current hybrid methodologies and practices current in industry that improve upon the systems development life cycle (SDLC), including marketable program management methodologies as they are relevant to SOA as a strategy. The instructors and the students may not be learning the methodologies, organizational practices or processes that matter in industry investment of technology (McAleer and Szakas, 2007, p. 4). They may not be learning technology as business technologists, but as programmers or technologists that are not as in demand by business firms as business technologists (Raths, 2007).

Instructors might begin to initiate improvement in SOA by incrementally integrating such practices into current curricula of information systems or in a new curriculum on SOA, referencing the IS 2006 curriculum model (McGann, Frost, Matta and Huang, 2007) so that undergraduate students might be learning the proposition of SOA as business, culture, methodology and research in tandem with the technology. It is important that industry practices on SOA not be integrated into a couple of courses, but in a cumulative curriculum of courses. Schools of information systems might furnish grant incentives to instructors to prepare such curriculum on SOA, and technology firms might furnish grants (Ericson, 2007). Grants might include process modeling software, such as IBM INNOV8 Simulator, to the instructors, in order to provide the business proposition of SOA as a strategy.

Importance of including students in an experiential project of research in industry is a final implication of the preliminary study. In this study, a senior undergraduate student in information systems initiated the research of technology firms marketing SOA, though such researchers are frequently graduate students (Reif, Clarke and Choi, 2007). Literature indicates increased learning of researcher students leading to the likelihood of graduate study (Prince, Felder and Brent, 2007), if not increased learning of instructor researchers (Sama, 2007) leading to innovation in curricula (Karukstis, 2007). Learning of instructor researchers might be further increased in methodologies and technologies of SOA if the research is in partnership with the business firms or the technology firms. Manager practitioners of the firms might be hosted at consortiums in schools of information systems and might inform on practices and technologies of SOA, or be informed of high potential students, or they might be invited to join councils in the schools and might inform instructors and researchers on the currency of the curricula on SOA (Hoffman, 2008) and on positions in information systems at the firms. Research might lead to internships or positions of undergraduate students at the firms. In short, integrating senior, junior or sophomore students in the research of instructors might lead undergraduate students sooner to positions in the field of information systems if not to tangible responsibilities as the next generation of business technologists.

LIMITATIONS AND OPPORTUNITIES IN RESEARCH

Once the final analysis and final implications are completed by the author in a revised report, the study may be continued in a direct and expanded survey of business firms that have completed programs of projects of SOA that are closer in completion in an SOE, which may dissipate concerns as to the generalizability of the findings of the study. The feasibility of such study is constrained by the few

business firms experienced in services (Gosain, 2007) in an SOE strategy. Though experienced in services in an SOA strategy, they are largely only on a journey in an SOE strategy (Ozair, 2008). Study could be done of the few firms in expanded in-depth case studies of an industry, but confidentiality of the strategies in the firms may inhibit the researcher. The instructor plans to introduce a new program of study on SOA at the Ivan G. Seidenberg School of Computer Science and Information Systems of Pace University, in which further research on SOA might be done by groups of students in field internships with financial firms on Wall Street, with whom the school is a frequent incubator on studies. The program is introduced in the previous Table 2. This research may be an interim solution in the study of SOA, with findings that may improve upon this study.

CONCLUSION

The preliminary findings of the study continue to confirm the earlier findings of the authors in the higher importance of business and procedural factors in the management of SOA strategy. Technical functionality is found to be less important than the procedural and business factors of the strategy. The importance of a bona fide program management methodology on SOA is also indicated in this study. These findings contribute input to practitioners designing SOA strategy. This methodology integrating the business and procedural factors and the technical factors may be input into the curricula of instructors in schools of information systems. The authors will conclude the final findings and will continue to research SOA as industry matures in strategy, and they will suggest ideas for educators and practitioners in new and timely studies.

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Acknowledgement

The principal author of the paper acknowledges release time granted to him by the Dean of the Ivan G. Seidenberg School of Computer Science and Information Systems of Pace University in spring 2008 in order to complete this study.