

# Change Management in Service Oriented Virtual Organizations

## *A Structural Framework to Identify the Impacts and Triggers of Changes*

Waeal J. Obidallah<sup>1,2</sup> and Bijan Raahemi<sup>1</sup>

<sup>1</sup>*Faculty of Graduate and Post-Doc Studies and Telfer School of Management, University of Ottawa, Ottawa, Canada*

<sup>2</sup>*Collage of Computer and Information Sciences, Imam Mohammed ibn Saud University, Riyadh, Saudi Arabia*  
{wobidall, braahemi}@uottawa.ca

**Keywords:** Virtual Organizations, Service Oriented Architecture, Change Management, Change Classification, Triggers of Changes, Levels of Changes.

**Abstract:** Business processes and services of Service Oriented Virtual Organizations are subject to change to meet the internal and external requirements of the competitive, complex and rapidly changing collaborative environment they operate in. Efficient and practical change management solutions are needed to enable the partners to gain insight on the various triggers of change, and their impacts on the Virtual Organization's operations and collaboration. This paper presents a structural change management framework to facilitate the process of change by allowing the participating partners in a Virtual Organization to identify and understand the levels and the triggers of changes in their environment. Our proposed solution consists of the structural framework including two layers, namely, the levels of changes, and triggers of changes. We present an example scenario to demonstrate how employing the proposed framework to identify, recognize and categorize various changes in the Service Oriented Virtual Organization improves the flexibility, and agility of the change management in the organizations.

## 1 INTRODUCTION

The evolution of web technologies and services has transformed the internet from a mere repository of information and data into a useful and an inevitable platform for service provisioning and sharing. It enables businesses from different locations to share information, and resources in the form of Collaborative Networked Organizations (CNOs) where they share risk, skills, resources and core competencies to add more competitive advantages to their organizations (Akram et al., 2010). The result of this is the emergence of the virtual organizations (VO), which is a dynamic, temporal consortium of autonomous legally independent organizations that collaborate with each other to achieve certain objectives and meet business needs (L. M. Camarinha-Matos et al., 2008). The idea of aligning VOs with service oriented architecture (SOA) is potentially one of the best ways to implement, and manage dynamic business processes which led to the concept of a service oriented virtual organization (SOVO) (Danesh et al., 2011).

Since today's business environments are very competitive, complex, and rapidly changing; companies and different organizations are

increasingly restructuring, changing, and improving their internal business processes, services, information systems, and partnerships with other companies to leverage, and add more value to their businesses (Camarinha-Matos et al., 2008). The VO participating organizations need to evolve to meet the market and customer demands by changing their own business processes and services. Thus, the VO partners need to understand the levels, impacts, triggers and the consequences of changing their business processes and services to meet the market and customers' demands. Consequently, change management processes and procedures are needed to facilitate and manage the process of change in a collaborative way between different partners in the SOVO environment (Obidallah et al., 2013).

In this paper, we present a structural change management framework by identifying the levels and triggers of changes which improve the flexibility and agility in changing shared-services and business processes between different partners in the SOVO, enabling its partners to understand the triggers, categories, and impact of changes in their collaborative environment.

The rest of the paper is organized as follows: In Section 2, we introduce our research motivation. In

Section 3, we describe changes in the Service Oriented Virtual Organizations (SOVO) by referring to the concept of virtual organization (VO), service oriented architecture (SOA) and change management. This is followed by our proposed structural change management framework in Section 4. Example scenarios of changes in the SOVO are described in Section 5. Finally, we conclude the paper in Section 6.

## 2 MOTIVATION

VOs are dynamic and continuously changing because of the dynamic environments in which they operate (Liu and Bouguettaya, 2007). The idea of combining the SOA with the VO presents many advantages in today's business environments, but it also introduces new research challenges. Industry analysts state that one of the leading causes of downtime and missed Service Level Agreement (SLA) is unmanaged change. Furthermore, the Gartner Group stated that enterprises should invest more to improve change management processes, problem management processes and automation tools to address 80 percent of unplanned downtime. This will help organizations to reduce downtime caused by application failures and operator errors (Dumitraş et al., 2007). The various changes in the SOVO environment are expected to be organized and managed in a way that allows participated partners to evolve and change their own business processes and services accordingly. Therefore, a framework that identifies and clarifies the impact and triggers of change, in addition to the processes and procedures for handling all levels of changes plays a central role in the successful deployment, operation and evolution of the SOVO.

Consider a VOWireless where a Cell Phone provider and a Wireless Network provider collaborate with each other to provide a final product which is a cell phone with activated wireless plan delivered to the customer. The Cell Phone service provider and the Wireless Network service provider share their business process and service together to form a Virtual Organization, called VOWireless. Figure 1 illustrates the value network of VOWireless. The value network focuses on a group of entities who work and collaborate together to achieve certain business goals. It models the business value between different organizations to form a complex chain that includes multiple services providers who interact and communicate with each other to increase business value exchange (Ul Haq

and Schikuta, 2010). VOWireless can expect changes to its business processes and services from different sources, where changes could be triggered for different reasons. For instance, the performance of the VO might be below the acceptable threshold, or a new business strategy might be defined. If the performance level of cell phone service provider does not meet the SLA, then VOWireless needs to react to this trigger of change, and understand how this change affects the VO operations and collaboration. The change can impact the VO in different levels depending on the severity of the change. Each change within VOWireless will affect the business process and services shared in the VO in different aspects and levels, as well.

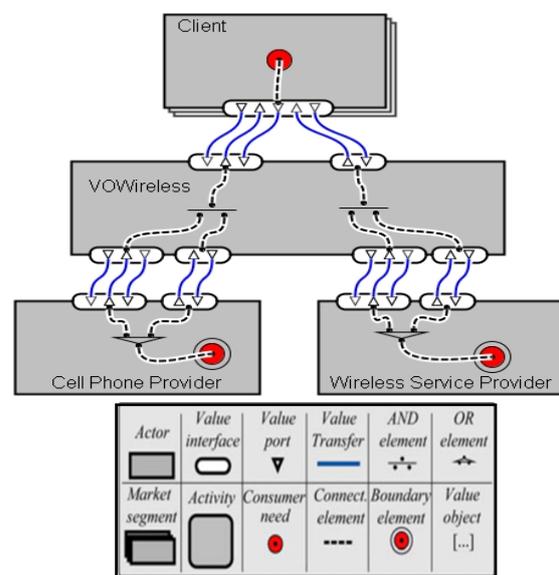


Figure 1: The VOWireless value network.

Since VOs faces and initiates different kinds of changes in order to meet the markets' and customers' demands, a VO such as VOWireless should employ a change management mechanism which identifies the levels, impact and triggers of changes, and facilitates the process of changing business processes and services by engaging all partners in the change process in a collaborative and efficient way. In this paper, we are focusing on identifying the levels, impact and triggers of changes in the SOVO environment.

### 3 BACKGROUND

#### 3.1 Virtual Organization

Collaborative Networked Organization (CNO) has emerged as a result of greater awareness on the potential benefits and advantages offered by networking, partnerships and collaborations between different organizations to meet requirements (Camarinha-Matos et al. 2008). A Virtual Organization (VO) is a dynamic, temporal consortium of autonomous legally independent organizations that collaborate with each other in a way to attend a business opportunity, and meet specific requirements. VOs are very important manifestation within CNOs (Drissen-silva and Rabelo, 2008). The VO participating partners share risks, costs, and benefits, coordinate the sharing of skills, resources and competences to achieve their operations and use computer networks to support their interactions (Drissen-silva and Rabelo, 2008; Camarinha-Matos et al., 2008). The VO looks and performs its tasks and activities as if it was a single organization even though each VO participating organization is independent by having its own objectives, internal processes and business culture. This fact makes it challenging to manage the VO like a single organization (Jansson et al., 2008).

VOs have four phases in their lifecycle as show in Figure 2 (Drissen-silva and Rabelo, 2008). The VO management is “the organization, allocation and co-ordination of resources, their activities as well as their inter-organizational dependencies to achieve the objectives of the VO within the required time, costs and quality frame” (Negretto et al., 2008). Its challenges can be categorized into distribution, dependencies and coordination challenges, change management challenges, performance management challenges, knowledge and information management challenges, risk management challenges, and decision making challenges (Karvonen et al., 2004; Jansson et al., 2008).

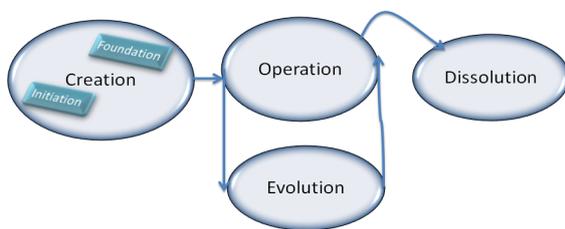


Figure 2: The VO's Life-Cycle.

#### 3.2 Service Oriented Architecture

Service Oriented Architecture (SOA) is an architectural style where systems consist of service users and service providers (Bianco et al. 2007). The SOA provides interoperability between different services through the use of different standards; loose coupling that minimizes dependencies and just requires the awareness between services, and abstraction which hides the logic of service from the outside world using technologies such as XML, reusability which is the ability to reuse a certain services in different business processes, autonomy which allows services to have control over the logic they encapsulate which is governed by policy and, finally, discoverability where metadata are used to discover a service (Erl, 2005). Building business applications using the SOA increases the agility and flexibility of business processes, the interoperability between different services and their reusability. The SOA is the proper way to create dynamic and collaborative applications that are built for change because it is able to adopt with the dynamic business environment. It also reduces the complexity and rigidity of developing IT or business applications compared to other ways such as client-server where changes may require rebuilding the whole application again (Holley and Arsanjani, 2010).

#### 3.3 Change Management

Our research is primarily focused on the technical aspect of change management. Change Management (CM) from an IT perspective is "a process whereby changes to a service are formally introduced and approved before deployment into the next testing or production state (Holley and Arsanjani, 2010)." It focuses on changes to a service through its whole lifecycle and ensures the prompt and efficient handling of all changes through the use of standardized methods and procedures based on industry best practices (Holley and Arsanjani, 2010). The goal of CM is to support the process of change, enable the traceability of changes, identify and minimize the impact of change and gradually improve the day to day operations (OGC, 2007). Organizations believe that virtual business models, such as the SOVO, include innovations with the potential to respond to complex and dynamic changing business environments, as well as provide benefits and various opportunities that are not found in physical organizations (Abuelmaatti and Rezgui, 2008).

Business processes and services in SOVOs are

subject to changes in order to evolve and improve its operations to meet markets and customers' requirements. The process of managing changes becomes more complicated and complex as the number of services or service providers increases dramatically (Akram et al., 2010). Managing changes between different partners manually is not practical especially with the growing number of service providers and the improvements in Information and Communications Technologies (ICTs). A more practical and efficient way is to automate the process of change between different partners allowing a quicker and user transparent way of CM. This will allow a quicker response time for changes and less efforts from the VO manager to track, maintain and coordinate for change (Akram, 2005). During the operation phase of VOs different kinds of unexpected events take place for different reasons which may cause a problem to maintain the VO's operations and achieve its objectives (Drissen-Silva and Rabelo, 2009). The unexpected events may lead to changes in the VO that require decision making, problem solving, discussion making and collaboration between independent and autonomous partners (Drissen-silva and Rabelo, 2008). A specific change to a service or business process may force a series of changes due to the dependency between services and business processes (Wang et al., 2010). The dependency between different business processes and services, in addition to the complexity and the characteristics of a SOVO makes the process of change more challenging and complicated. Therefore, change management is an important research subject which needs to be investigated to enable the VO partners to adapt to the dynamic and changing environment. The CM processes will facilitate change while also reducing user effort which eventually leads to faster VO change adoption.

## 4 PROPOSED STRUCTURAL FRAMEWORK FOR SOVO CHANGE MANAGEMENT

Our proposed change management structural framework consists of two layers which are: (a) the levels of changes; and (b) the triggers of changes in the SOVO. These two layers of the structural framework are described in more details in the following sub-sections.

### 4.1 The Levels of Changes

Changes in the SOVO are triggered for different reasons and in different levels during the operation phase of the VO. These changes could start from different sources to meet the VO goals and customer expectations. The fact that the three modelled layers of the SOVO; the value network layer, the collaborative process layer and the service providers' layer, are dependent to, related, and connected with each other, makes changes in the SOVO more complex. This complexity is due to the fact that a change in one of the SOVO layers may initiate changes in the other layers. Figure 2 illustrates the levels of change, and their impact on the SOVO environment.

In general, our proposed framework classifies changes in the SOVO into:

- High level changes: represent changes in the business layer of the SOVO. This includes changes in the value network layer and the collaborative process layer.
- Low level changes: represent changes in the service layer of the SOVO. This includes changes in the SOVO service providers' layer.

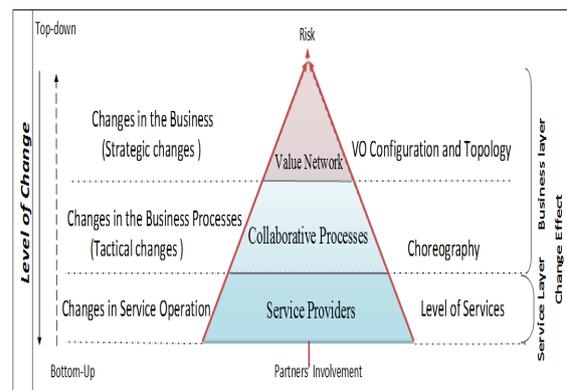


Figure 3: The levels of changes in the SOVO.

#### 4.1.1 Value Network Layer Changes

The value network changes are high-level changes in the business processes, which affect the configuration and topology of the VO, and at some stages questions the feasibility of the VO itself. In the SOVO, the value network specifies the roles and interactions between different partners developed during the creation phase of the VO. Any changes in the value network are considered critical and require business decision-making and negotiation between the different VO partners involved.

Changes in the value network layer will affect

the VO's operational configuration, and topology. Changes in the VO's "operational configurations" are referring to the changes in the consortium of the legally independent organizations, their service contributions, value exchange and Service Level Agreement (SLA), which will impact the value added to the VO. In this layer, the value exchange among the SOVO partners can be any kind of service, money, product and information, which partners have agreed on during the creation and business opportunity discovery phase of the VO Lifecycle.

Changes in the VO "topology" are referring to the modification needed in the structure through which the VO partners interact and communicate with each other. The VO topology could be a supply chain topology where each partner communicates with its upper and lower neighbours; a star topology with a central authority where the collaboration between different partners is organized in star-like pattern between the central partner and other organizations; and a peer-to-peer topology where each partner is able to communicate and interact with the other partners without hierarchy or central authority (Danesh et al., 2011). Changes in the SOVO value network layer will cause changes in the collaborative process layer and service providers' layer.

#### 4.1.2 Collaborative Process Layer Changes

Collaborative process changes are high-level changes in the business processes, which affect the choreography of the VO. Collaborative processes are high-level business processes which are defined to model the collaboration and integration between various organizations. The collaboration between different organizations in the SOVO is modelled using the service choreography, which focuses on collaboration and service interaction. It specifies each partner's role, activities and the sequences of service invocation.

Changes in the collaborative process layer means changes in the VO choreography. Changes in the choreography include changing in partners' roles, their assigned activities, and the service invocations. Changes in the collaborative process layer may or may not propagate to the changes in the value network layer (although, it might in the long-term) and require partners' negotiation and decision making. Furthermore, changes in the collaborative process layer will propagate to the lower level changes in the VO partners shared services.

#### 4.1.3 Service Providers' Layer Changes

Service providers' layer changes are low-level changes in the VO service layer, which affect the level of the services provided by the VO partners. The VO partners can request a change in their VO shared services which affect the VO service providers' layer. The VO service providers can initiate *functional* and *non-functional* changes to their shared services. Functional changes refer to the changes that affect the functionalities of the service shared in the VO. It includes changes in the shared Web Services provided by the VO partners. These changes are initiated by the service providers, and affect the VO in the service providers' layer. Functional changes can be classified into structural and behavioural changes. Structural changes refer to the changes in the operational aspect of the shared services, whereas, the behavioural changes refer to the service providers' changes in its interactions with the VO in the collaborative process layer, or with the other service providers. Functional changes in service providers' layer occur when the web service description (WSDL) is modified (Akram et al., 2010).

Non-functional changes refer to the changes that are triggered from the VO partners' performance perspective. The privacy, security, reputation and availability are some of the performance measurements that service providers can consider in initiating changes to their communication and interactions with the VO or other service providers.

The involvement of the VO partners in the process of change increase as we move from the low-level changes to the high-level changes. This means, the number of partners involved in the change decision making and problem solving process will increase going from low level change to more complicated high level changes. Furthermore, the VO itself will face the risk of dissolution and the question of its feasibility as we move from the low-level changes to the high-level ones. If the VO participants were not able to collaborate with each other to solve the problem effectively, the VO will eventually dissolve.

#### 4.2 The Triggers of Changes

The fact that the VO has distributed and independent partners causes changes in the SOVO occur more frequent. Changes can be initiated in different levels of change during the operation and evolution phase of the VO. These changes can be triggered for different reasons by the VO coordinator, change

management team or even by the VO partners themselves. Figure 3 illustrates different reasons which could lead to the change in the VO at the different levels.

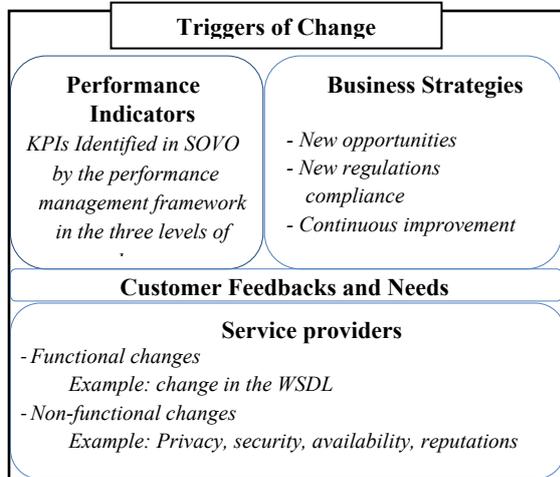


Figure 4: Triggers of change in the SOVO.

The performance indicators in the SOVO are defined in the performance management framework in the three levels of changes. Each level has its own key performance indicators (KPIs) to measure the performance of operation at that level. The VO performance management framework identifies the performance measurement criteria and their threshold which automatically trigger a change in one of the three layers (Kamali et al., 2012). This trigger of change is an internal trigger to the SOVO, based on its performance.

Customer feedbacks and needs can automatically trigger a change. The customers' feedbacks measure the external performance of the VO, and call for the future improvements in the VO services. By categorizing customers' feedbacks, and applying a predefined threshold, an event will be triggered if the customers' negative feedback passes the threshold. This external trigger will alert the SOVO change management team to investigate the problem, which may lead to the changes in the VO

Business strategies can trigger changes in the VO to meet new goals, objectives, or to add more values to the consortium of the independent organizations. The rapidly changing environment that the VO operates in forces it to adopt new strategies to achieve sustainable competitive advantage. The VO coordinator or the VO change management team can manually trigger changes in the VO based on the business strategies agreed on. Changes in the environment, markets, new business goals and shift

in the VO operation force the business to trigger changes to meet their new strategies and objectives. Adopting a new VO business strategy can be triggered due to internal or external forces.

Service Providers can manually trigger changes to their shared services in the VO for functional or non-functional changes. A service provider can trigger a change in the VO by triggering a request for change (RFC) on his/her shared service. A service provider may trigger an RFC to update his service, which is being shared in the VO by adding new functionality or modifying the properties of the service.

## 5 EXAMPLE SCENARIOS OF CHANGE

The following scenarios demonstrate various triggers of changes at different levels of change. The VOWireless identified earlier is considered to demonstrate the scenarios.

Starting with the performance indicator as a trigger of change, assume that the "availability" of the VOWireless cell phone service provider does not pass the SLA threshold. This triggers an event and alerts the change management team. The problem then needs to be investigated by identifying its root cause. A possible solution could be substituting the cell phone service provider with a new one who is able to meet the agreed level of "availability". This is a change in the value network layer which will affect the VO topology and configuration, and will cause changes in the collaborative process layer, affecting the VO choreography. Furthermore, it will cause low level changes, affecting the service provider level. This change requires negotiation and business decision making between the VO participating organizations. This change needs a new VOWireless value network, new service choreography and new cell phone service provider.

Next, considering the business strategies as a trigger of change in the SOVO, VOWireless may initiate changes to add more values to their customers by adding a shipping service provider to the VO. The shipping service provider handles shipping the final product to the customers. This is a high level change in the value network which involves adding a new service provider to the VO. It will affect the VOWireless value network configurations and topology, and will cause changes in the collaborative process and service providers' layer. The change requires a new value network as

illustrated in Figure 5, new service choreography derived from the new value network, and a shipping service provider.

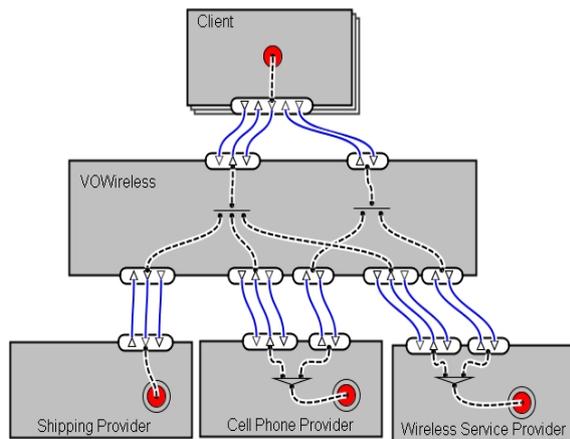


Figure 5: The modified VOWireless new value network.

Finally, considering the wireless service provider can trigger a change in VOWireless to change the shared service by updating the WSDL file that describes the service, and the way it is called. This is a low level change in the service providers' layer. Since it will not change the functionality (behavioural) of the service, it will not propagate to the higher levels of change in the VO. The wireless service provider can initiate the change by updating its shared service, and publish it again to be shared in the VOWireless.

## 6 CONCLUSIONS

The rapidly increasing number of web services, combined with the idea of virtual organizations (VO) to offer new services in a dynamic collaborative environment, introduces new challenges in their change managements. The VO members must constantly monitor the changes in their environment, and react to them in order to meet the market and customers' needs through improved services. With prior knowledge of the impacts, consequences and categories of the changes, combined with a predefined change processes, the VO participating organizations can respond quickly and flexibly to market demands to remain profitable and competitive.

We proposed a framework that guild the VO participants in identifying the impact, categories, and triggers of change in the SOVO environment. We specified a structural framework which include

the level and triggers of change in the SOVO. The levels of change identified the SOVO three layers of change which include the value network layer, the collaborative process layer and the service providers' layer. The trigger of change identified different internal and external reasons which lead to change in the VO. This include the VO performance indicators, the customer feedbacks and needs, The VO business strategies and the service provider changes We presented different change scenarios based on the identified triggers and levels of change. The presented scenarios demonstrate how the VO and its partners can use the change management structural framework to understand the impacts, categories, triggers and severity of changes on the VO operations and collaborations.

Our next research plan is to identify and validate a change management *procedural framework* which provides a process of change based on the Information Technology Infrastructure Library (ITILV3), Engineering Change Management (ECM) and European Collaborative networked Organisations Leadership (ECOLEAD) best practices, recommendations and reference models, customized for the SOVO environment's change requirements.

## REFERENCES

- Abuelmaatti, A. & Rezgui, Y., 2008. Virtual Organizations in Practice: A European Perspective. In *Proceedings of the 14th Americas Conference on Information Systems (AMCIS)*. p. 142.
- Akram, M. S., 2005. *Managing Changes to Service Oriented Enterprises*. State University.
- Akram, S. et al., 2010. A change management framework for service oriented enterprises. *the international journal of next-generation computing*, 1(1).
- Bianco, P., Kotermanski, R. & Merson, P., 2007. *Evaluating a Service-Oriented Architecture*.
- Camarinha-Matos, L. M., Afsarmanesh, H. & Ollus, M., 2008. ECOLEAD and CNO base concepts. In *Methods and Tools for collaborative networked organizations*. Springer, pp. 3–32.
- Danesh, M. H., Raahemi, B. & Kamali, M. A., 2011. A framework for process management in service oriented virtual organizations. In *Proceedings of the 7th International Conference on Next Generation Web Services Practices*. IEEE, pp. 12–17.
- Drissen-silva, M. V & Rabelo, R.J., 2008. A model for dynamic generation of collaborative decision protocols for managing the evolution of virtual enterprises. In *Innovation in Manufacturing Networks IFIP – The International Federation for Information Processing*. Springer, pp. 105–114.

- Drissen-Silva, M. V. & Rabelo, R. J., 2009. A collaborative decision support framework for managing the evolution of virtual enterprises. *The International Journal of Production Research*, 47(17), pp.4833–4854.
- Dumitraş, T. et al., 2007. Ecotopia: An ecological framework for change management in distributed systems. *Architecting Dependable Systems IV Lecture Notes in Computer Science*, 4615, pp.262–286.
- Erl, T., 2005. *Service-oriented architecture: concepts, technology, and design*, Prentice Hall.
- Holley, K. & Arsanjani, A., 2010. *100 SOA Questions: Asked and Answered*, Prentice Hall.
- Jansson, K. et al., 2008. Governance and management of virtual organizations. In *Methods and Tools for collaborative networked organizations*. pp. 221–238.
- Kamali, S. M. A. et al., 2012. A framework for performance measurement in service oriented virtual organizations a value network approach to collaborative performance measurement. In *Proceedings of the 2010 International Conference on e-Business*. pp. 263 – 271.
- Karvonen, I. et al., 2004. Challenges in the management of virtual organizations. *Virtual Enterprises and Collaborative Networks- IFIP International Federation for Information Processing*, 149, pp.255–264.
- Liu, X. & Bouguettaya, A., 2007. Reacting to functional changes in service-oriented enterprises. In *Proceedings of of the International Conference on Collaborative Computing: Networking, Applications and Worksharing*. IEEE, pp. 264–270.
- Negretto, U. et al., 2008. Vo Management Solutions VO Management e-Services. In *Methods and Tools for collaborative networked organizations*. Springer, pp. 257–274.
- Obidallah, W. et al., 2013. Service oriented virtual organizations: A service change management perspective. In *Proceedings of the 26th IEEE Canadian Conference on Electrical & Computer Engineering (CCECE)*. IEEE, pp. 0–5.
- OGC, 2007. *Service transition*, United Kingdom:: TSO (The Stationery Office).
- Ul Haq, I. & Schikuta, E., 2010. Aggregation patterns of service level agreements. In *Proceedings of the 8th International Conference on Frontiers of Information Technology - FIT '10*. New York, New York, USA: ACM Press, pp. 1–6.
- Wang, Y., Yang, J. & Zhao, W., 2010. Managing Changes for Service Based Business Processes. In *Proceedings of the 2010 IEEE Asia-Pacific Services Computing Conference*. Ieee, pp. 75–82.