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Business Process and Service Change Management in Service Oriented Virtual Organizations

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In the Name of God, Most Gracious, Most Merciful

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ABSTRACT

Service Oriented Virtual Organizations (SOVOs) business processes and services are subject to change to meet the internal and external requirements of the competitive, complex and rapidly changing environment they operate in. More practical and efficient ways of change management are needed to allow different partners to initiate changes to their business process and services in a faster and user-transparent manner.

This thesis proposes a Change Management Framework for service oriented virtual organizations including a *structural* and a *procedural* framework. The structural framework categorizes changes in the SOVO into three layers of change; which include the value network layer, the collaborative process layer and the service providers' layer, and identifies the impact of change on each layer. Furthermore, the structural framework identifies various triggers of changes which eventually lead to actions taken at the three layers.

The change management procedural framework is derived from the ITIL V3, ECM and ECOLEAD best practices and recommendations, customized to fit the SOVO change requirements. It provides different components including the six layers for change processes, change control, change actors and related management processes. The change management procedural framework provides a sequence of steps and methods that the SOVO and its participated organizations can follow in initiating changes to their business processes or services.

We design an implementation architecture and a prototype for building the change management console which enables the SOVO change management participants to initiate, assess, collaborate, monitor and authorize changes. The prototype is developed to realize and validate the change management process of change in the SOVO environment. We employ the various capabilities of the IBM Business Process Management (BPM) (including its recent Web 2.0 capabilities) to increase the collaboration between partners in the process of change. We demonstrate that the proposed solutions facilitate and enhance the process of change by effectively engaging the SOVO partners in the process of change.

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List of Abbreviations

B2B: Business-to-Business

BI: Business intelligence

BPEL: Business Process Execution Language

BPM: Business Process Management

BPMN: Business Process Model and Notation

CA: Change Authority

CAB: Change Advisory Board

CM: Change Management

CN: Collaborative Network

CNO: Collaborative Networked Organization

DSRM: Design Science Research Methods

DSRP: Design Science Research Processes

ECM: Engineering Change Management

ECOLEAD: European Collaborative networked Organizations LEADership initiative.

HCN: Horizontal Collaborative Network

ICT: Information and Communications Technologies

IT: Information Technology

ITIL: Information Technology Infrastructure Library

ITSM: Information Technology Service Management

KM: Knowledge Management

OLA: Operation Level Agreement.

SLA: Service Level Agreement

SMEs: Small and Medium Enterprises

SOE: Service Oriented Enterprise

SOVO: Service Oriented Virtual Organization

VCN: Vertical Collaborative Network

VO: Virtual Organization

VOM: Virtual Organization Management

Chapter 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 inevitable platform for service provisioning and sharing. It allows businesses from different locations to share information and different resources to increase collaboration to form Collaborative Networked Organizations (CNOs) in which they share cost, skills, resources and core competencies to add more competitive advantages to their organizations (S. Akram, Bouguettaya, Liu, Haller, & Rosenberg, 2010).

The result of this, is the emergence of the virtual organization (VO), which is a dynamic, temporal consortium of autonomous legally independent organizations that collaborate with each other in a way to achieve certain objectives and meet business needs (L. M. Camarinha-Matos, Afsarmanesh, & Ollus, 2008; M. H. Danesh, Raahemi, & Kamali, 2011). The idea of aligning VOs with the service oriented architecture (SOA) is potentially one of the best ways to implement and manage dynamic business processes to achieve the concept of a service oriented virtual organization (SOVO) (M. H. Danesh et al., 2011). This will increase the flexibility and agility to improve and change business processes and services (Bloor, Hurwitz, Kaufman, & Halper, 2009) in the SOVO.

Since today's business environments are very competitive, complex, and rapidly changing, companies and 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 (L. M. 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, change processes and procedures are needed to facilitate and manage the process of change between different partners in the SOVO environment.

1.1 Major Concepts

This section provides readers with a definition of concepts needed to understand the research context.

- *Virtual Organization (VO)*: “ a VO is a dynamic, temporal consortium of autonomous legally independent organizations that group with each other in a way to address a business opportunity or cope with specific needs, where partners share risks, costs and benefits, and whose operation is achieved by a coordinated sharing of skills, resources and competencies.” (Driessen-Silva & Rabelo, 2008).
- *Service Oriented Architecture (SOA)*: " The SOA is an architecture for building business applications or software as a set of loosely coupled black-box components orchestrated to deliver a well-defined level of services by aligning business processes and IT together, which will add more flexibility and agility to the processes "(Bloor et al., 2009). It is the key enabler for the development of Web-based Virtual Enterprises such as the SOVO (S. Akram et al., 2010).
- *SOA Technical Change Management*: “Technical change management in the SOA is a process whereby changes to a service are formally introduced and approved before deployment into the next testing or production state.” (Holley & Arsanjani, 2010). It is responsible for handling and managing the proposed changes to a service portfolio in a way to minimize the impact of change, and perform the change successfully based on industry best practices (Holley & Arsanjani, 2010).
- *Virtual Organization Evolution Phase*: The evolution phase is one of the VO Lifecycle phases that concentrates on aligning the VO operations with a dynamic and changing environment in which any kind of changes that need to be implemented in the VO are handled and executed (Dimitrakos, Golby, & Kearney, 2004; Drissen-silva & Rabelo, 2008). This is the phase in which all changes to the VO business processes and services are handled.
- *Service*: “A means and a way to deliver value to customers by facilitating the outcomes that customers want to achieve without the ownership of specific costs and risks.” (OGC, 2007a).
- *Business Process*: “Coordinated chain of activities intended to produce a business result or achieve business needs” (Tripathi & Hinkelmann, 2007).

- *Collaborative Process*: “Collaborative processes are high-level business processes defined to model collaboration and integration between organizations”.
- *Business Process Management (BPM)*: includes methods, techniques, and tools to support designing, modeling, automating, managing, monitoring, and analyzing of business processes. It is considered an extension of the classical Workflow Management (WFM) systems and approaches (Ashtiani, 2012).
- *VO Participant / VO Partner*: represents the organizations involved and partly responsible for the fulfillment of the objectives and tasks in the current VO environment.
- *Procedure*: specified way to carry out an activity or a process, describes “how” and “who” executes an activity. A procedure may include stages from different processes (Jong, Kolthof, Pieper, & Bon, 2008, p. 11).

1.2 Research Problem

Service Oriented Virtual Organizations (SOVO) operate in a dynamic infrastructure that facilitates distributed business process execution by integrating different partners and their processes, while providing a manageable abstraction layer for every partner to enforce mediation, policy and security mechanisms, that facilitate each organization’s autonomy (M. H. Danesh et al., 2011). In the evolution phase of the VO Lifecycle, the VO participating organizations are changing their own business processes and services to evolve and meet the rapidly changing market and customers’ expectations.

The fact that a VO operates in a constantly changing and complex environment, results in continuous changes within the business processes and services shared by the independent organizations to meet the customers’ and markets’ requirements (Drissen-silva & Rabelo, 2008). The process of changing the VO-shared business processes and services are some of the challenges facing the SOVOs, which are important to investigate and consider.

It is difficult to initiate and implement changes to shared processes and services in the SOVOs without affecting the performance, and the operations of the value creation. However, the negative impact of changes can be minimized by using a series of processes

to facilitate, and manage the process of change between different partners (Dumitraş, Roşu, Dan, & Narasimhan, 2007).

The VO participating organizations can trigger changes to their business processes and services for different reasons, and in different levels, which will affect the overall VO operations and performance. Therefore, developing and designing high-level processes based on the Information Technology Service Management (ITSM) best practices for managing changes, offer the best potential for facilitating the process of change to business processes and services in the SOVO.

Various researches such as (S. Akram et al., 2010; Dumitraş et al., 2007; Liu & Bouguettaya, 2007; Tripathi & Hinkelmann, 2007; H. Wang, Zhang, & Ge, 2010; Y. Wang, Yang, & Zhao, 2010) have investigated changes in the SOA by categorizing the types of changes, the triggers of changes, the impact of changes and providing a model to react to change. However, to the best of our knowledge, there has been no other research that provides a step-by-step process that facilitates a change following the best practices, and focusing on change process, change control procedures, change collaboration and change automation in a *multi-organization* environment (i.e. among different partners). As such, this research will identify:

- A mechanism that participating organizations can initiate changes to the services they share with other partners in a multi-organization environment. This includes different steps to introduce the change, and its implications to the VO change management team, and obtain their feedback after reviewing process.
- Triggers of changes: since changes in the SOVO environment can be triggered for different reasons, and at different levels, identifying the triggers of change is needed.
- Change Management Framework: changes can be initiated at different levels within the VO. Depending on what type of change is needed; it may require low level or high level change implementations. Identifying these levels of changes offers the opportunity for developing the change management framework.
- How the identified levels of change can affect the feasibility of the VO itself, and its operations to meet its SLA (Service Level Agreements).

- How ITSM best practices (such as the ITIL v3) and other Change Management (CM) references can facilitate the change process in a SOVO.

Table 1-1 shows the research's objectives and the problem statement.

Table 1-1: Framing the Research Problem

Steps	Description
Observation	- The SOA governance and management are essential for the success of the SOA implementation; this includes the SOVO's change management process. - SOVO operates in a changing and dynamic environment in which participants initiate or request some modification to their shared business processes and services in order to evolve.
Thesis	A set of business processes and service change management frameworks in the SOVO are important for the successful implementation, and adoption of changes in a shared service environment. It is challenging because the processes involved for the change to be successfully implemented affects different business layers within the VO.
Enthymeme	Because the SOA has a higher likelihood of failure without a proper change management framework (Holley & Arsanjani, 2010), a framework to facilitate and control changes in a SOVO is required. The proposed framework should engage all partners, and operate within different levels to achieve the anticipated levels of services.
Problem Statement	Because the SOVO operates in a dynamic environment, participants are continuously changing their processes and services to meet market and customer demands, which will affect the overall VO operations and performance. Therefore, developing and designing high-level processes or steps that are based on the ITSM best practices and other change management framework is necessary to facilitate, manage and control changes in the SOVO.
Objectives	• Develop a <i>framework</i> to facilitate the process of change in business processes and services at the VO different levels by providing a roadmap for partners to initiate, manage, and share

	their changes to shared services in the VO. The framework includes both the <i>structural</i> and <i>procedural</i> change management frameworks. • Facilitate and improve the processes of change by identifying the <i>triggers of changes</i> and the <i>three levels of changes</i> which include the value network level, the collaborative process level, and the service providers' level to form the change management structural framework. • Provide a step-by-step processes and procedures that the VO and its participated organizations can follow to initiate changes to their business process and service to form the change management procedure framework. • Increase the flexibility and agility of changing business process and service in the SOVO environment by engaging all the VO participated organizations in the process of change in a collaborative environment. • Design and implement a prototype for managing changes in the SOVO environment to realize and validate the proposed change management structural and procedural frameworks.
Research Questions	1. How can participating organizations initiate changes to their shared services in a multi-organization environment such as the SOVO? 2. What are the triggers of change in a SOVO-based business process and service environment? 3. What are the levels of changes in the SOVO? 4. How can different levels of changes affect the VO itself? 5. How can change management best practices and frameworks facilitate the process of change in the SOVO?

1.3 Research Motivation

Combining a service oriented architecture with the concept of virtual organizations (VO) to create a service oriented virtual organization (SOVO) presents many advantages in today's business environments, although VOs also introduce new research challenges (M. H. Danesh et al., 2011). VOs are dynamic and continuously changing because of the

dynamic environments in which they operate (Liu & Bouguettaya, 2007). This requires changing the VO shared business processes and services to meet customer and market demands. Changes in market conditions, enforcing new business regulations, new business strategies, new business opportunities, the emerging of new technologies or adding a new partner to increase the VO capability all could trigger changes in the SOVO environment.

Industry analysts argue that one of the leading causes of downtime (and, consequently, not meeting the service level agreement) is unmanaged change. Furthermore, the Gartner Group states that enterprises should invest more to improve their change management processes, problem management processes and automation tools to address 80 percent of unplanned downtime. This will help organizations reduce downtime caused by application failures and operator errors (Dumitraş et al., 2007).

All kinds of changes to the SOVO environment are expected to be organized and managed in a way to allow the VO to evolve and change its own business processes and services. Therefore, a framework that provides processes and procedures for handling all levels of changes will play a central role in the successful deployment, evolution and operation of the SOVO. This framework should be able to initiate, manage, and approve all kinds of changes at different levels.

This research focuses on providing a framework to facilitate and coordinate the process for changing business processes and services in a multi-organizational service oriented environment such as the SOVO. The new framework will provide flexibility and agility in changing shared services and processes between partners by engaging all of them in the change process.

1.3.1 Motivating scenario

Consider an Automobile Enterprise where the entrepreneur is looking to combine different services including Search, Purchase, Insurance, Finance and Shipment as illustrated in Figure 1-1. The lists of the virtual services are identified by the entrepreneur. Different physical organizations are providing these services, which will be selected, composed and orchestrated to meet the purposes of the VO.

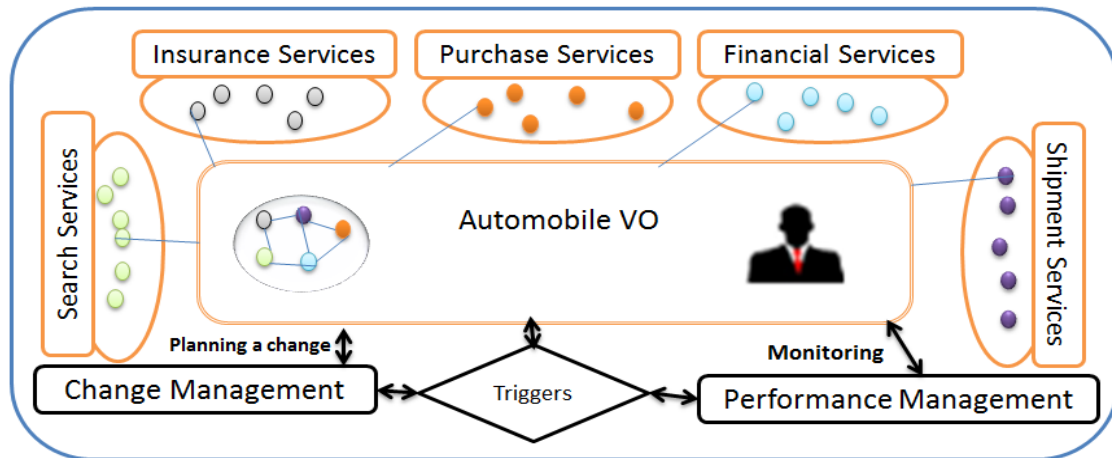


Figure 1-1: Motivating Scenario

The VO will go through various phases of its Lifecycle, starting from the *creation* phase, where a business opportunity is identified, the list of services is selected and orchestrated. In this scenario, the Automobile VO allows users to search for a car, purchase by providing information, and makes payments through financial services. Furthermore, they have the choice of buying insurance, and shipping the purchased car to their location. The entrepreneur can choose the right search, purchase, insurances, financial and shipment services that are provided by different organizations. After the orchestration, all of these organizations collaborate as partners to achieve the expected value by going through the *operation* phase of the VO Lifecycle.

The *evolution* phase is when the VO makes changes to its business processes and services based on different aspects. Changes could be triggered due to different reasons. Monitoring the performance of the VO could be one reason, and a new business strategy could be another. For example, if the performance of the partner who provides the shipment services does not meet the SLA and OLA, the VO will react by replacing that partner with a new service provider who is willing to or can meet the expected SLA and OLA. Other examples could be an increase in the price of the service by any of the service provider, adding a new service to the VO (e.g. Car Bidding Service), new parameters required to collaborate between partners, all of which need to be considered and much more. Finally, once the VO has outlived its value, it will be *dissolved*, and all partnerships will be terminated.

During the evolution phase, the VO members will face and initiate different kinds of changes in order to meet the markets' and customers' demands. Thus VOs, such as this the Automobile VO, should employ a change management mechanism which facilitates the process of changing business processes and services by engaging all the VO partners in the change process.

1.4 Research Objectives

The main objective of this research is to develop a change management framework for business processes and services in a SOVO environment. The framework should be able to facilitate the process of changing business processes and services by providing a roadmap for participating organizations (partners) to initiate, assess, collaborate, authorize and implement their changes to the shared services in the VO. The change management framework includes both the structural and procedural framework. The focus is on the IT perspective of change management (and not, for instance, on the cultural or human aspects of it).

Developing the change management structural framework helps the VO, and its participated organizations by understanding the levels and the triggers of changes in the SOVO. The levels of change in the SOVO include the value network level, the collaborative process level and the service provider's level where changes could be triggered at any level. Furthermore, the structural framework identifies the impact of change in each level of change, and how the change affects the VO operation and collaboration. For example, some of the SOVO changes may affect the overall VO composition, whereas other changes may only affect certain level of services. Furthermore, we investigate and discover the triggers of these changes in the SOVO. These include the different reasons that may cause the VO participants to consider initiating changes to their business process and services.

Developing the change management procedural framework, which provides a step-by-step processes and procedures that the VO, and its participated organizations can follow to initiate changes to their business process and service, which helps the VO to evolve successfully. Increase the flexibility and agility of changing business processes and services at various levels in the SOVO environment by engaging all the VO

participated organizations in the change process in a collaborative manner. Design and implement a prototype for managing changes in the SOVO environment to realize and validate the proposed change management structural and procedural frameworks using the IBM tools.

1.5 Methodology

1.5.1 Design Science Research Methodology for Information Systems

The Design Science Research Methodology (DSRM) for Information System (IS) incorporates principles, practices, and procedures required to carry out Information System researches and meets objectives (Peppers, Tuunanen, Rothenberger, & Chatterjee, 2007). Design research is inherently a problem solving process that creates and evaluates IT artifacts intended to meet business needs, and solve the identified organizational problems (Hevner, March, Park, & Ram, 2004).

After about two decades of conducting the DS Research in Information Systems, it is still evolving. However, most researches in this discipline follow almost the same procedures and steps. The guidelines for the DS Research were presented by Hevner et al (2004), to assist researchers understanding Design Science Research in IS, and determine when, where, and how to apply the guidelines in a research as illustrated in Table 1-2.

A formalized DS Research process (DSRP) model is presented by Peppers et al (2007), which consists of six activities in a normal sequence as shown in Figure 1-2. The first activity of DSRP is problem identification and motivation where specific research problem is defined, and the value of the potential solution is justified. This activity requires knowledge about the state of the problem, and the importance of the solution. The second activity is to define the objectives of the solution where the objectives should be inferred rationally from the problem definition and specifications.

Table 1-2: Design Science Research Guidelines
(Hevner et al., 2004)

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

The third activity is the design and development of IT artifactual solution. This includes identifying artifact's functionality, its architecture and then developing the actual artifact.

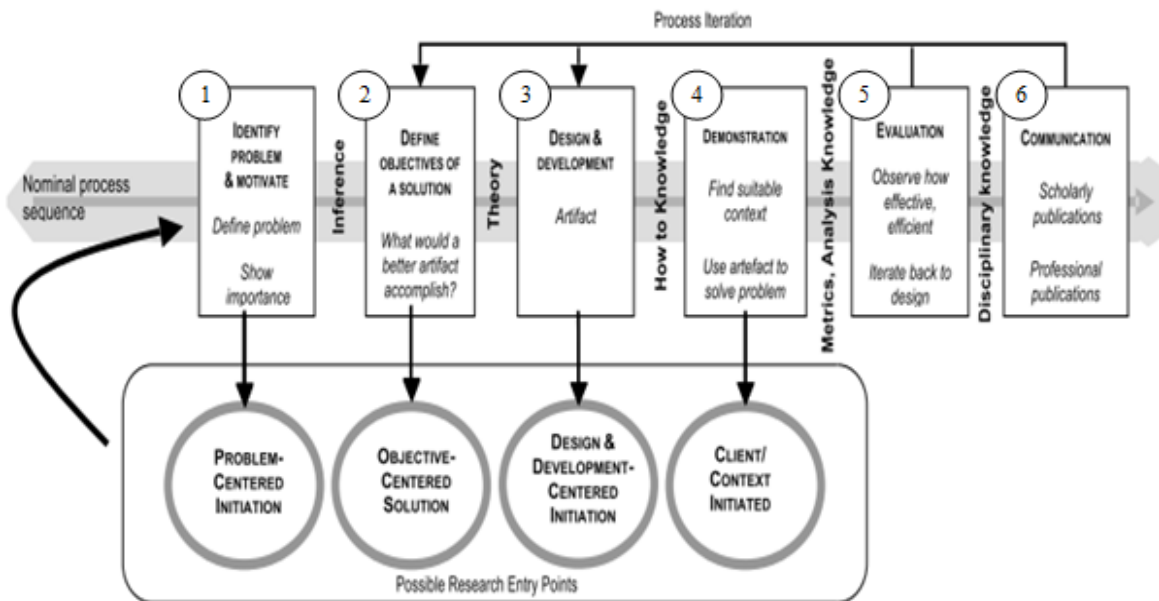


Figure 1-2: The DS Research Methodology
(Peffers et al., 2007)

The fourth activity is to demonstrate the efficacy of the developed artifact in solving one or more instances of the research problem. This may involve its use of

experimentation, proof, simulation, case study or any other appropriate activity. The fifth activity is to evaluate and observe how the developed artifact will support a solution to the research problem. This activity includes comparing the objectives of the solution to the actual results from using the artifact in the demonstration activity. The nature of the research may dictate whether iteration to activity three is feasible or not. The sixth activity is to communicate the problem, the artifacts, its importance, its utility, and its effectiveness to researchers and other audiences.

According to Peffers et al (2007), the DSRP is structured in a nominally sequential order, but researchers can actually start at any step, and move to the next. The basis of the nominal sequence is the problem-centered approach, which starts with activity one. If the idea for the research resulted from observation of a certain problem or from suggested future research work in a paper or a prior project, researchers can proceed in the sequence of the problem-centered approach. The nature of the research can help researchers identify their DS Research possible research entry points.

1.5.2 Research Method and Activities

We apply the problem centered approach of the design science research methodology (DSRM) for Information Systems presented by Peffers et al (2007), and align our method with the seven guidelines of design science presented by Hevner et al (2004). The activities we follow in this research are as follows:

1. **Problem identification and motivation.** We identify the target domain for our research the SOVO Change Management, the specific research problem, the main requirements, challenges and the value of the proposed solution.
2. **Define the objectives for a solution.** We explain how the new artifacts are expected to support, and provide a solution for the problem. We analysis some of the existing change management framework and references to specify our design strategy for developing the SOVO change management framework.
3. **Design and development.** We design the new framework, which involves determining the artifacts' desired functionality and architecture and then developing the actual artifacts. In our research, these include developing the structural and

procedural framework to articulate the distinctive features, and core components of the overall propose framework.

4. **Demonstration.** We use a prototyping to prove our concept; we apply the proposed framework in the context of the SOVO where the process of change implemented using the IBM BPM to connect the VO participated organizations in the process of change for the purpose of demonstrating the utility of the framework.
5. **Evaluation.** We observe how the artifacts support a solution to the problem. We examine the proposed framework by looking at its capabilities and evaluating the fitness of the SOVO change management. We compare between the objectives of the solution, and the actual observed results from using the framework in the demonstration. We use common Design Sciences Research Evaluation methods presented in Hevner et al (2004) where we follow the descriptive method by conducting detailed scenarios around the developed framework to demonstrate its utility. Furthermore, we use qualitative analysis for the evaluation.
6. **Communication.** We communicate the results of this research with our peers in the forms of conference and journal publications. A list of publications is provided in Chapter 5 “Conclusions”.

The research problem is formalized to discover and understand the characteristics of the changes, and their relationships with different components. We follow a descriptive approach to determine how and where to apply change management best practices and frameworks to handle and facilitate a change request to improve business processes and services in the SOVO. Figure 1-3 illustrates our activities following the DSRP methodology.

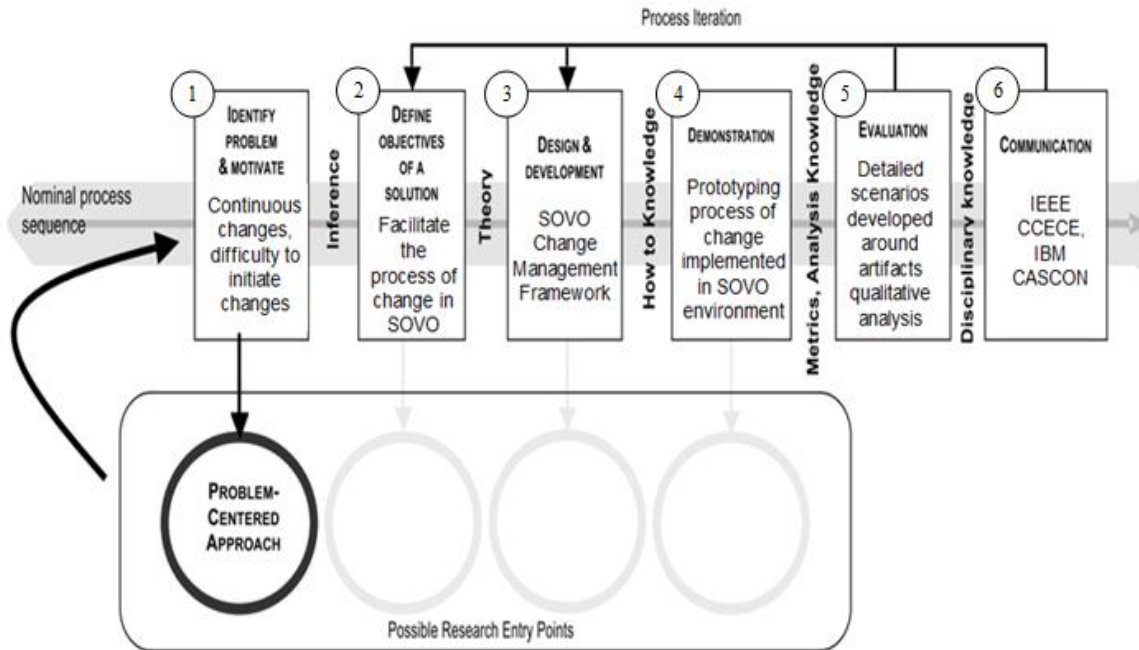


Figure 1-3: The DSRP for SOVO CM

Table 1-3 illustrates the seven phases and the activities of our research following the DSRM methodology:

Table 1-3: Research Phases and Activates

No#	Phase	Activities
1	Literature review and problem identification	- Introduction to CNOs and VOs. - Research the challenges of VOs and their management. - Investigate Service Oriented Architecture and its application to the VO evaluation and management. - Investigate the VO change management challenges. - Study previous Academicals efforts presented for the VO evolution and change management. - Investigate existing change management frameworks, best practices including the Information Technology Infrastructure Library (ITIL V3) and Engineering Change Management (ECM). - Investigate ECOLEAD recommendations for the VO evolution and management.
2	Define the objectives of the solution	- Acquire a clear definition of the problem. - Identify the solution requirements. - Identify why SOVO trigger changes. - Identify the taxonomy of changes. - Identify the level of changes.

		- Choose the right change management framework, best practices that fit for a SOVO environment.
3	<i>Designing and developing the framework</i>	- Identify the requirements of the SOVO CM framework considering the challenges and the recommendations. - Map the requirements to fit the SOVO different levels of change. - Develop a SOVO change management framework considering the VO characteristics, requirements and the existing CM Framework. - Analyze the proposed framework components.
4	<i>Implementing change Management processes</i>	- Model the prototype for the SOVO CM based on the proposed procedural CM Framework to include change process, control, collaboration and automation. - Learn to work with the IBM BPM including the process designer and the integration designer. - Get familiar with the SOVO Performance Measurement implantation. - Implantation of the modeled the SOVO CM procedural Framework using the IBM tools. This includes the process of change that the VO partners will follow to initiate changes in a collaborative way.
5	<i>Testing and validation</i>	- Design different scenarios to initiate changes between partners in the SOVO. - Implement test scenarios to validate the overall change process. - Observe the agility and flexibility of changes. - Testing, evaluating and validating the results.
6	<i>Comparative study and Communication</i>	- Comparing our proposed framework with other change management framework. - Indicate future work, lessons learned, and limitations. - Prepare for scholarly publications.
7	<i>Summarizing, writing, and defending the thesis</i>	

1.6 Thesis Contributions

The thesis focuses on providing a framework that facilitates and coordinates the process for changing business processes and services in a SOVO. We contribute to the virtual organization's evolution by facilitating the process of change between participating organizations, which will enable better *change control*, *change collaboration* and *change*

automation. Change Control ensures that standardized methods and procedures are used to quickly review and evaluate proposed changes in order to approve/ disapprove it. *Change Collaboration* ensures the VO participants can collaborate and communicate to provide, discuss and analyze solutions for the problem before implementing it. *Change Automation* provides a way to automate the process of change by engaging all the VO members in the process using a business process management application and its social aspects such as the IBM Business Process Manager (BPM) 8.0.

The main contributions of the thesis are:

- Identify various levels of changes in the SOVO with their impact on the VO, and its participated organizations and their collaboration: We propose a *structural framework* that identifies the level of changes in the SOVO. The level of change layer includes more details about high-level changes, and low-level changes, and its impact on the VO operations and collaborations. This will help the VO and its participated organizations in understanding what kind of changes they may face, and how it affects the VO operations and collaboration.
- Identify the triggers of business processes and services changes in the SOVO: The trigger of changes layer in the *structural framework* identifies various reasons that justify why the VO initiate changes to its business processes and services. The trigger of changes layer identifies different reasons, which involves different parties and aspects contributed in triggering changes. The changes lead to an action at the VO level of changes.
- Design a change management procedural framework that the VO participating organizations can follow to facilitate the process of change in the SOVO: The change management procedural framework provides step-by-step processes and procedures that the VO, and its participated organizations can follow to initiate, assess, collaborate, authorize and implement changes to their business processes and services. The framework is derived from the ITIL v3, ECM, and ECOLEAD reference frameworks, and customized for business processes and services changes in a virtual organization setup.

- We propose a prototype and implementation architecture for the change management processes, and the change management console to simulate changes to the VO business process and service in different levels: the VO members follow the procedural framework to initiate, assess, collaborate, authorize and implement changes, and use the change management console to trigger changes and monitor the efficiency of changes after the implementation. The implemented change scenarios initiate changes at different levels, and interact with the SOVO Performance Measurement (PM) Framework, Process Management Framework and other management interfaces.

1.7 Thesis Organization

This thesis is organized in five chapters. In Chapter 2, we review the literature from different perspectives where we present the current literature about collaborative networked organizations (CNOs) and virtual organizations (VOs). We discuss the VO Lifecycle, topologies and its management, control and customers' processes. We present the management challenges facing the VO in its Lifecycle, and the different VO management approaches. Then, we introduce the Service Oriented Architecture (SOA) as a reference model for the creation and the integration of business services and processes. We discuss change management including the organizational and the technical change management, and the benefits of facilitating the process of change in the SOVO. Finally, we introduce the ITIL v3, which provides a set of guidelines and best practices for the IT service management including change management; and the Engineering Change Management (ECM), which provides different activities and recommendations to support the process of change in distributed environments.

In Chapter 3, we introduce our propose change management framework to facilitate the process of change between the VO participated organizations. This framework includes a *structural* and a *procedural* frameworks. The structural framework includes two layers, which are the triggers of changes and levels of changes. The procedural framework defines step-by-step processes that the VO participated organizations can follow to initiate changes to their business processes and services. The procedural

framework focuses on providing change process, change collaboration, change control, change automation, and has interfaces with different related management framework.

In Chapter 4, we present our prototype implementation of the propose SOVO CM procedural framework and apply different VO change management scenarios in various levels of changes. By showing how the VO initiate changes in different details scenarios, and by providing qualitative analysis, the proposed solution is evaluated and validated. Finally, we present our recommendations and observations regarding the current solution, and ways to improve it.

In Chapter 5, we conclude our research by providing a summary of our research contributions, the resulting publications, and discussing the research limitations and future works.

Chapter 2 : Literature Survey

In this chapter, we review the relevant literature, referring to the current state-of-the-art work in the field of business process and service change management in a Service Oriented Virtual Organization (SOVO) environment. Figure 2-1 demonstrates our literature review map, which starts from topics that are more general, and then, proceeds to topics that are more specific in the context of implementing Change Management in the SOVO.

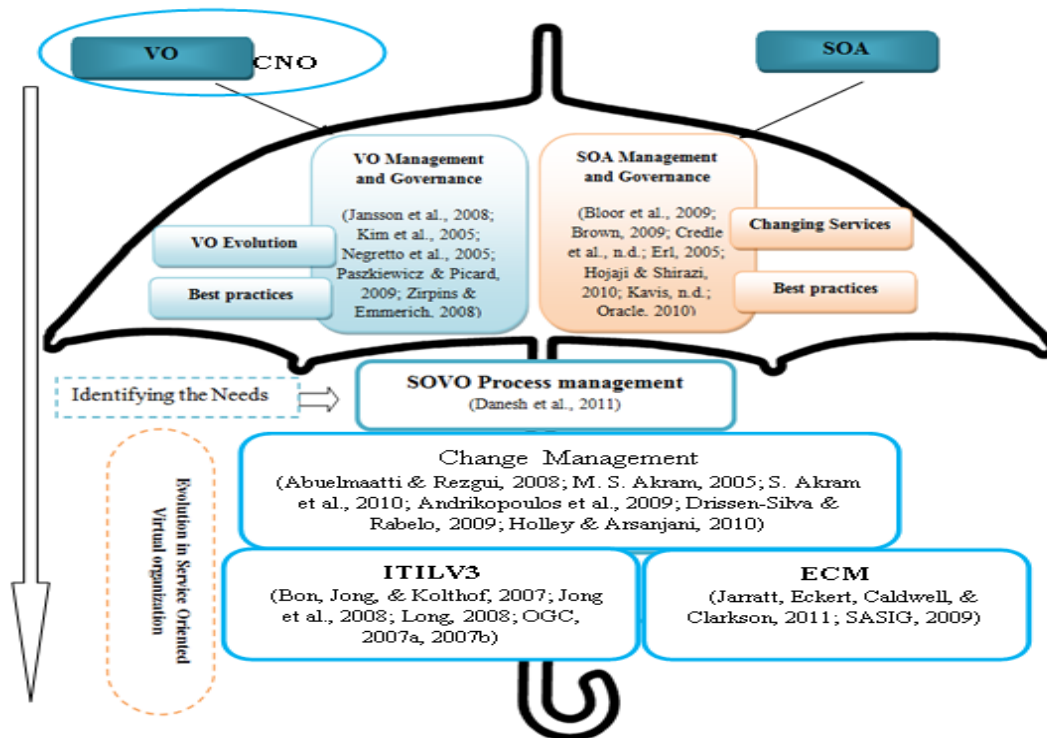


Figure 2-1: Literature Review Map

More than 25 related books, journal articles, conference papers, and reports are surveyed to answer the following questions:

1. What is the Collaborative Networked Organization (CNO)?
2. What are VOs and what is the SOA?
3. How is the SOVO constructed?
4. What is a technical change management and organizational change management?
5. Why the SOVO participants change their business processes and services?
6. What are the triggers of change?

7. What is the ITIL V3 and its role in managing changes?
8. How can the ECM manage changes in a collaborative environment?

2.1 Collaborative Networked Organizations

Companies continuously looking into increasing and growing their businesses worldwide, but they are facing some challenges to adapt with the dynamic and changing environment where they operate. Today's business environment has become more comparative and challenging, especially for small and medium enterprises (SMEs), which have limited resources, skills and infrastructure (L. M. Camarinha-Matos et al., 2008). Organizations need to be dynamic and innovative to address the increasing markets and customer demands. For this reason, they need to improve their competencies by dealing with new business strategies, models, governance principles, processes and technological capabilities adopt to the demanding and changing environment (L. M. Camarinha-Matos et al., 2008).

The global competition has forced organizations to restructure their internal processes and information systems. This has led to several organizational transformations, and the development of high-tech information and communication technologies (ICT) to support them (Swarnkar, Choudhary, Harding, Das, & Young, 2011). Organizations are changing the nature of their operations by partnering with other organizations to form a Collaborative Network (CN) to increase capabilities, reduce operating expenses, share knowledge and resources (M. V. Drissen-Silva & Rabelo, 2009). As businesses continually face more complicated markets, CN provides a new form of collaboration over a network of entities. The nature of this collaboration is more knowledge-driven in contrast with the traditional data-driven networks (L. M. Camarinha-Matos et al., 2008).

A Collaborative Network (CN) is a network that consists of a variety of entities (e.g. organizations, people, and even machines) that are legally autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals. These entities collaborate to better achieve common or compatible goals and jointly achieve values. The interactions between the entities are supported by computer networks (L. M. Camarinha-Matos et al., 2008; Swarnkar et al., 2011). A CN

can be a horizontal collaborative network (HCN) or vertical collaborative network (VCN). In the VCN, the competencies of the organization needed to achieve a project are complementary, and it could be considered a combination of different supply chains. On the other hand, organizations that belong to the HCN are working on the same competencies to meet the market and customer demands (Swarnkar et al., 2011).

The concept of the Collaborative Networked Organization (CNO) has emerged as a result of greater awareness of the potential benefits offered by networking, partnerships and collaborations between different organizations to meet the market and customers' demands (L. Camarinha-Matos & Afsarmanesh, 2007; L. M. Camarinha-Matos et al., 2008). The CNO members need some sort of distributed business process management, integration, coordination, and the right Information and Communication Technologies (ICT) in order to survive through their Lifecycle (M. H. Danesh et al., 2011).

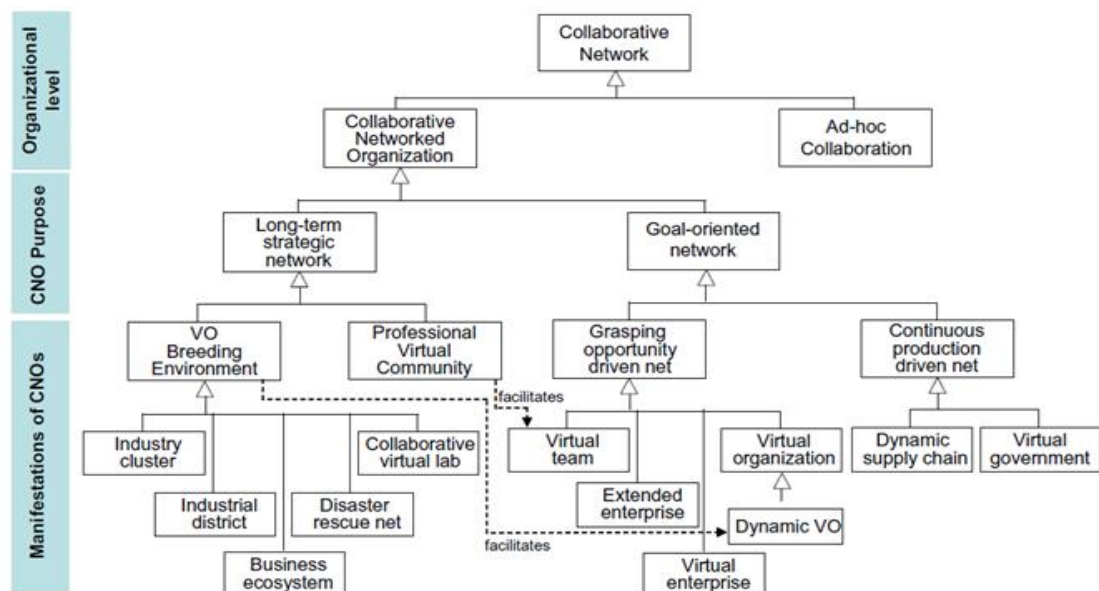


Figure 2-2: Taxonomy of Collaborative Network
(L. M. Camarinha-Matos et al., 2008)

The wide variety of different CNs' taxonomies, and the emergence of new organizational paradigms have led to the generation of several related terms (Swarnkar et al., 2011). Figure 2-2 illustrates the CN taxonomies and identifies different CNO terms such as virtual organizations (VO), virtual enterprises (VE), extended enterprise, virtual team, professional virtual community, virtual breeding environment, etc. (L. M.

Camarinha-Matos et al., 2008). In our research, we are focusing on goal-oriented and opportunity-based organizations, which is the Virtual Organization (VO).

2.2 Virtual Organizations

Virtual Organizations (VO) are a very important manifestation within the CNOs defined as 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 (Drissen-silva & 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 (L. M. Camarinha-Matos et al., 2008; Drissen-silva & Rabelo, 2008). From the outer world point of view, 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 difficult to manage the VO like a single organization (Jansson, Karvonen, Ollus, & Negretto, 2008).

The VO participating organizations collaborate with each other by employing collaborative processes, which leverage the capabilities of each partner. To do so, they need to share risks, resources, responsibilities, losses and rewards. The collaboration between different organizations to form a virtual organization involves mutual engagement of autonomous partners to solve problems that benefits every one of them. This requires mutual trust, commitment, governance and management between participants to ensure the survival of the VO. Determining partner contributions in the VO value creation process are much more difficult compared to other levels of collaboration in networked organizations (L. M. Camarinha-Matos et al., 2008; Rabelo & Gusmeroli, 2008). The lifetime of a VO is limited where the VO partners collaborate to achieve certain goals while going through the VO Lifecycle. It finally dissolves after the purpose of the VO has been achieved, and it is no longer needed (Jansson & Eschenbaecher, 2005).

2.2.1 Virtual Organization Life cycle

Physical organizations are spending a negligible fraction of their Lifecycle on the initiation and the creation of their organizations whereas the operation and evolution

phases constitute their entire livelihood (Afsarmanesh, 2008). For VOs, the creation, initiation and termination phases are more complex and require considerable time, effort and attention. Figure 2-3 illustrates the four phases of the VO Lifecycle.

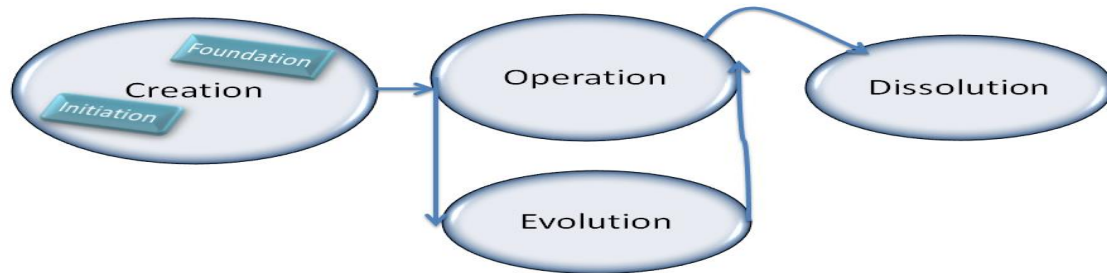


Figure 2-3: The VO Lifecycle

Creation Phase

The VO creation phase focuses on discovering and formalizing a collaborative business opportunity, proposing a collaborative solution to address that opportunity and selecting the candidate VO partners. The creation phase is divided into initiation and foundation stages. Due to the lack of information, common collaboration infrastructure and preparedness of process development, finding and selecting the right VO partners is challenging (M. Danesh, Raahemi, Kamali, & Richards, 2011). This phase involves three main stages, which are preparatory planning, consortia formation and the VO launching (Romero & Molina, 2009).

In the preparatory planning stage, the collaboration opportunity is identified based on competency requirements. Afterwards, the collaborative characteristics are identified and analyzed for the required opportunity. A feasibility study for different strategies and a rough plan for the VO are needed (Afsarmanesh, 2008; M. Danesh et al., 2011; Romero & Molina, 2009).

The consortia formation stage is about searching, suggesting and assessing the potential VO partners, where different technical, economical, preferential and reliability elements need to be considered. An iterative negotiation activity take place to align different partners' capabilities which result in agreement and governance principles for the VO structure (Romero & Molina, 2009). All the VO partners' tasks and responsibilities will be assigned after the negotiation part which is called the VO composition (M. Danesh et al., 2011).

In the VO launching stage, final details for the VO operation are adjusted such as collaborative business process modeling, the VO topology selection, definition of sharing principles and operation policies. The VO is launched after participating partners sign a contract to regulate the VO collaboration and benefit sharing (Romero & Molina, 2009).

Operation Phase

The second phase of the VO Lifecycle is about the execution of the processes and activities agreed upon according to the detailed operation plan. It is also about controlling the integration between services and resources, and providing feedback about the VO's everyday activities and operations (Romero & Molina, 2009). Since the VO is launched, it is important to monitor and measure the performance of the VO as a whole and, also; measure the performance of each single VO partner's activities. This can be done by setting Key Performance Indicators (KPIs) to measure the VO and partners' performances (Romero & Molina, 2009).

The VO performance measurement is concerned about providing visualization, monitoring and alerting functionalities by investigating different kinds of data and information that are coming during the operation of the VO from participating partners' interactions. The monitoring functionality detects exception conditions that may require the evolution of the VO, which leads to a change in the VO to achieve its values. The alerting functionality notifies the VO about its current status and progress during the entire VO Lifecycle (Afsarmanesh, 2008; Romero & Molina, 2009). These functionalities track the performance of the VO and notify the VO coordinator or manager about any changes in the VO's status, which may trigger an alert that needs a strategic response. This trigger may require changes in different levels of the VO.

Evolution Phase

The third phase of the VO Lifecycle concentrates on aligning the VO operations with its dynamic and changing environment. Throughout the operation of the VO, different conditions can trigger modifications and changes the VO's detailed plan. Different exception conditions such as partner substitution, activity and resource reallocations, new business strategies and opportunities will trigger the VO evolution processes (Romero & Molina 2009). The success of the VO depends on the capability to predict and detect

these kinds of changes in a pro-active way during the operation phase, and the ability to adapt to these changes continuously in the evolution phase.

The VO evolves by changing and modifying its own business processes and services in different levels to adapt with the changing and dynamic market conditions. The VO evolution phase with its feedback from the operation phase is responsible for the VO adaptation and change management (Negretto, Hodík, Král, & Mulder, 2008). The key in the evolution stage is having the right information, which should come from the market, service providers and the performance monitoring tool of the VO. If this is realized the VO would be able to handle the situation to prevent failure and make the most benefit out of the collaborative opportunity (Romero & Molina 2009).

In order to handle the evolution process, the VO participating organizations need to adopt different approaches to support the process of change in a distributed work environment. The VO evolution requires partner discussions, methodological guidance, decision protocols, performance measurements, governance and ICT infrastructure to provide a comprehensive collaborative change and decision making solution (M. Drissen-Silva & Rabelo, 2012). The evolution phase is the main focus of our research where we provide a change management framework. This enables the VO participants to initiate changes in the VO various levels by following a sequence of change processes and discuss these changes with other partners in a collaborative environment.

Dissolution Phase

Every VO's purpose comes to an end after achieving its own goals. Therefore, every VO faces a dissolution phase which focuses on separation of the VO partners and inheritance of its shared resources (L. M. Camarinha-Matos et al., 2008). VOs will face a stage where its purpose is no longer valid which leads to the dissolution of the VO. The VO Lifecycle may vary from very short term tasks which could be a couple of days for extensive deliveries that last for years (Jansson et al., 2008).

At the dissolution stage, the VO participating organizations break-off their collaborative process and partnership. Thus, there will be some rights, liabilities, knowledge, experience and information that need to be handled and transformed during this stage (Iris Karvonen, Jansson, Salkari, & Ollus, 2004). The knowledge and experiences gained through the operation of the VO could be useful for the preparation of

other VOs that have similar tasks. The challenge is how the VO members will be able to manage and inherit the important assets created from the past VO collaborations (Ashtiani, 2012).

The VO participating organizations need to handle and transform the heritage of the VO. The VO inheritance is “the practice of storing and passing on the experience and other non-proprietary assets created through collaboration in a VO” (Jansson et al., 2008). An effective and reliable VO inheritance management program needs to be in place to facilitate the inheritance process between different partners.

Table 2-1 summarizes the most important aspects and focus of each VO Lifecycle phases.

Table 2-1: The VO Lifecycle Focus

Lifecycle Phase	Focus
VO Creation	Discovering, formalizing a collaborative opportunity, proposing a collaborative solution, selecting VO partners and launch VO.
VO Operation	Executing processes and activities, controlling the integration between services and resources and providing feedback and monitoring for the VO’s everyday activities and operations.
VO Evolution	Aligning the VO’s operations with its dynamic and changing environment. VO change adaptation, change management, governance, collaborative change and decision making management.
VO Dissolution	Partner separation, managing and facilitating the inheritance of shared resources, knowledge and experiences.

2.2.2 Virtual Organization Topologies

The categorization of VOs depends on its different characteristics. One of the most common VO categories is based on the VO topology classification. By the VO topology, we are referring to the structure describing all the various relationships between the partners, which includes information flows, material flows, financial flows, control flows, responsibilities power relationship and decision-making (Jansson & Eschenbaecher, 2005). All of these flows are not always taking the same routes and directions. The topologies used to describe the flows do not usually provide more details about the relationship between partners, but details are needed when focusing on the VO management issues (Iris Karvonen, Salkari, & Ollus, 2005). There are three main topologies of VOs illustrated in the Figure 2-4 (Jansson & Eschenbaecher, 2005; Iris Karvonen et al., 2005):

1. **Supply Chain** is a topology where interactions between partners follow mainly a chain structure; a process-oriented approach, links are in a tiered structure with each partner relating to its upper and lower neighbours.
2. **Star Topology/Hub and Spoke Topology** where it has one central partner represent the main contractor where links and collaborations between partners are arranged; predominantly star-like between the central organization and the other organizations.



Figure 2-4: Topologies for Virtual Enterprises
(Jansson & Eschenbaecher, 2005)

3. **Peer-to-Peer Topology** is a project oriented approach where all organizations communicate and interact with each other without a central organization or hierarchy.

2.2.3 Virtual Organization Process Concepts

Processes in VOs can be divided into two categories: 1) management and control processes, 2) service to customer processes; operational processes. The management and control processes include different activities to coordinate and manage value creation. The operational processes include activities needed for creating value, which could be a product or a service to customers (Jansson & Eschenbaecher, 2005).

Operational processes describe the physical and informational flows, which are needed for the production of products or services (Iris Karvonen et al., 2005) ,and may include different processes depending on the task of the VO (Jansson & Eschenbaecher, 2005). Management processes describe the information and control flows of the VO guidance processes (Iris Karvonen et al., 2005) such as the VO performance monitoring and change management to define and implement measures for process improvement, and develop appropriate processes to manage any change successfully.

The VO operational processes are important because they set up the environment and requirements for the VO management. Setting up a complex and sophisticated VO management infrastructure to be applied to a complex operation will not provide the best

solution (Jansson & Eschenbaecher, 2005). On the other hand, operable and reliable operations processes make management more simple and effective.

A VO's operational topology describes the communication style for physical and information flow needed for the production of the product or service, while the management topology describes the authority and management principles for the VO guidance process (M. Danesh et al., 2011). The VO can follow one topology for the management process and a different one for the operational process (Iris Karvonen et al., 2005).

2.2.4 Virtual Organization Management (VOM)

A VO consists of co-operative independent entities that are collaborating for a common goal. From customers and outer world point of view, VOs assumed to look, behave and operate as if they were a single organization (Jansson et al., 2008; Negretto et al., 2008). The market and customers' demands are forcing different organizations to collaborate with each other to meet their customers' expectations. The fact that different organizations collaborate in a distributed and dynamic environment increases the need to have proper governance principles, management solutions, and best practices in order to achieve the VO's objectives (Jansson & Eschenbaecher, 2005).

The VOM provides a set of mechanisms and activities directing and controlling the VO operations in order to allow it to achieve its objectives (Jansson et al., 2008). The VOM applies knowledge, skills and experience to achieve the organization's objectives. A large extent of the VOM deals with and performed by humans, usually by taking the last decisions about management's actions as done by the VO manager. However, it is not always reliable and possible to rely on management experience especially in a VO environment. Thus, systematic means, approaches and tools are needed to facilitate its management (Jansson & Eschenbaecher, 2005).

Since each VO has its own goals and objectives and operates in different environments, therefore, different management approaches and principles need to be adopted. Traditional management approaches and principles can be customized to meet a VO's nature and needs (Karvonen et al., 2005). The VOM is defined as "the organization, allocation and coordination 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” (Jansson & Eschenbaecher, 2005; Negretto et al., 2008).

The ECOLEAD project identifies two elements for the VOM, which are needed especially in dynamic environments. These are:

- **Governance** consists of structures, processes, and best practices that control, guide, and ensure that the VO meets its business goals and objectives throughout its Lifecycle. Governance is used to understand the implication of power and the ability to suggest or force changes depending on the feedback provided from the VO operations (Jansson et al., 2008). The VO governance should outline the relationship between different partners and stakeholders, indicate the proper flow of information between different partners, ensure appropriate review issues, and ensure that appropriate approvals and directions for changes and improvements are obtained in a coordinated way (Jansson et al., 2008). Because of the limited duration of the VO, the VO manager with a certain level of authority and power should adopt the right governance principles to have effective management decisions (Karvonen et al., 2005).
- **Management** is about the operative coordination of common operational activities in order to achieve objectives. In general, management is about “directing and controlling a group of one or more people or entities for the purpose of coordinating and harmonizing them towards accomplishing a goal” (Jansson et al., 2008). The management of a VO relies on the governance approach and rules agreed for the specific VO. According to Jansson et al. (2008), the focus of the VOM is mainly on governance principles (structures) and management (operations) of services. As VOs aggregate different autonomous and independent partners, their management is multidisciplinary, complex, and critical for the success of the VO (Iris Karvonen et al., 2005).

In this research, when we refer to the VOM, we are considering both the governance and management elements described earlier. The ECOLEAD agrees that in order to manage the VO effectively, we need to consider both governance and management aspects (Jansson et al., 2008). The following table summarizes the most important aspects of the VOM.

Table 2-2: The VO Management Questions

(Jansson & Eschenbaecher, 2005; Jansson et al., 2008; Negretto et al., 2008)

VOM	
What	- Supervision, control and coordination of the VO activities, knowledge, resources, responsibilities and authorities. - Predefined mechanism, policy and rules needed for the survival of the VO.
Why	A successful and effective VOM will facilitate the achievement of the VO goals within the required time, cost and quality, which enables the VO to survive in a dynamic and changing environment.
When	The VOM starts at the creation phase of the VO Lifecycle, effectively and extensively operated during the whole operations phase and the evolution phase if the VO decides to improve or change something. The VOM ends at the dissolution phase. The lifetime of a VOM could be even more than that of the VO itself.
Impact	- Activities, coordination and actions required for planning, definition of rules, mechanisms, policies, change plans and procedures during or after the creation of the VO. - Activities and actions required for supporting decision making, performance management, and risk mitigation, reacting and setting up plans during the VO operation. - Actions, plans, communications, decision making and procedures required for supporting the evolution of the VO to meet the market and customers' requirements.
Responsibility	- Establishing the management structure is the main task and responsibility of the VOM. Although, some changes may occur depending on the nature, environment and tasks of the VO. - Some VOs do not need a specific manager when all the participating partners can maintain the dynamic system to meet VO objectives. On the other hand, in some VOs, the responsibilities of the VOM will be given to a VO manager. The VO manager will then be responsible for coordinating the VO activities by setting up the appropriate rules and procedures. - Defining new management roles and responsibilities maybe needed and will be assigned to different actors. For example, defining roles for the VO change manager, the VO auditor or the VO steering committee.

VO Management Challenges

The VO management faces different challenges during its Lifecycle. The main challenges in the VOM come from the temporary nature of the VO, the distributed operations between different partners, different culture, goals, and behaviour. Furthermore, the dynamic and changing environment that the VO operates in needs a dynamic management, which is able to react and respond to these environmental requirements.

These requirements may lead to the restructuring of management's approach or even the VO topology and configuration (Jansson & Eschenbaecher, 2005; Jansson et al., 2008). These challenges force the VOM to rely on coordination to achieve the VO goals by creating trust and considering risks, acting on incomplete information and without forcing power between different partners (Negretto et al., 2008).

Dynamic management is also needed in the VOM. It indicates that management actions should be identified in real-time. Thus, an efficient performance management system with key performance indicators (KPI) and measurement criteria should be in place to provide real-time performance measurement for the VO's operations (Jansson & Eschenbaecher, 2005). The success of the VO depends on the efficient measuring of the partners and their collaborative processes (Jansson et al., 2008).

Since a VO is a goal driven alliance with a short lifetime period and changing environment, some of the challenges include solving problems, managing changes and decision making between different partners with high quality and transparency relying on trustworthy information, knowledge sharing and governance aspects (M. V. Drissen-Silva & Rabelo, 2009). Some other challenges come from the sharing of responsibilities and resources, increased importance of information and knowledge, risk of information unavailability, leaks, outdated or corrupted. These increase the need of having a risk management approach between the VO participating organizations (Iris Karvonen et al., 2004).

The challenges in the VOM can be categorized into distribution, dependencies and coordination challenges, performance management challenges, knowledge and information management challenges, risk management challenges, and changes and decision making challenges (Ashtiani, 2012; Jansson et al., 2008; Iris Karvonen et al., 2004).

VO Lifecycle Management

The complexity of the VOM makes it extremely difficult to define a model that covers all the requirements of managing it. The ECOLEAD project came up with a basic VOM process framework that indicates what kind of activities and processes are needed for the VOM while going through the VO Lifecycle phases. Several VOM processes and activities are occurring from the creation phase going through the other phases until the

dissolution phase as in Figure 2-5. The green processes are supported and addressed by the ECOLEAD project whereas the yellow ones still need further investigation (Negretto et al., 2008).

One way to deepen the understanding of the VOM is to identify its activities and link it to each phase of the VO Lifecycle. Each one of the VO Lifecycle phases has its own functions and activities, which are needed for effectively managing the VO as illustrated in Figure 2-5. The startup and establishment of management is the main task of the initiation phase. It includes different functions and activities such as setting-up the management structure; monitoring and coordination principles, setting up the VO topology, scheduling activities, and defining milestones and the KPIs (Negretto et al., 2008).

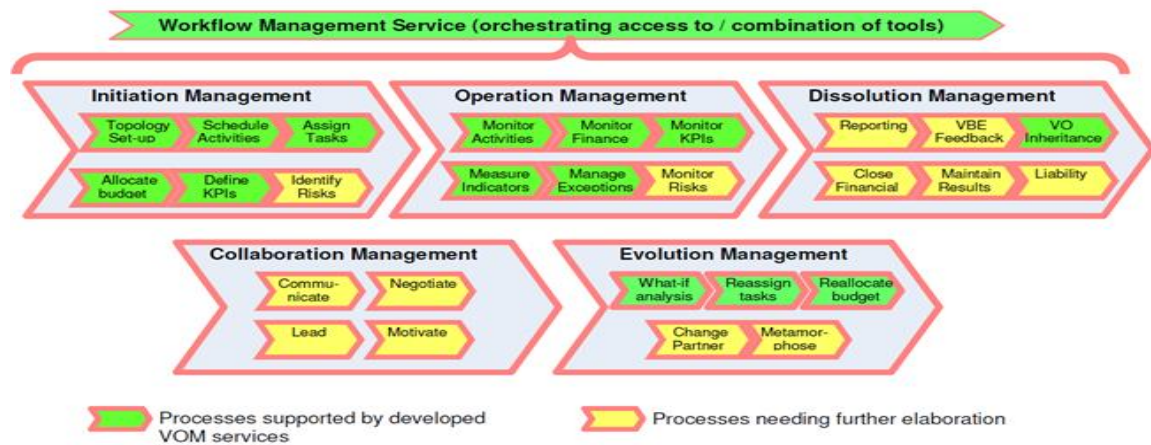


Figure 2-5: The ECOLEAD VOM Processes
(Negretto et al., 2008)

The VO operation management activities and functions are dedicated to take care of task fulfilment as well as the VO performance monitoring and coordinating. A real-time monitoring and performance measurements are needed to measure the performance of the VO and react based on the achieved performance (Jansson et al., 2008). If the agreed performance cannot be achieved then a revision needs to be done by going back to the initiation phase.

The VO evolution management offers the right directions for human decision makers by having problem solving techniques and systematic support to deal with unexpected events allowing the VO to react in a way that meets the VO's goals and objectives (Drissen-silva & Rabelo, 2008). The evolution management requires an

understanding of the change impact and change control, tracking and auditing, and providing status accounting (Andrikopoulos, Benbernou, & Papazoglou, 2008). According to Jansson et al. (2008) , Andrikopoulos, Benbernou, & Papazoglou (2009) and Drissen-silva & Rabelo (2008), evolution management shows and demonstrates the following aspects:

- Identification of all kinds of changes and the classification of these changes.
- Facilitating identification of a problem and its severity.
- Propagation analysis, change analysis and gathering of information about the effects of change to the VO.
- Application of the right procedure that leads to the final resolution.
- Ability to react by providing supporting methodology towards the problem resolution.
- Ensure collaboration between partners in solving encountered problems.

The VO dissolution management focuses on providing Virtual Breeding Environment (VBE) with feedback about the VO performance during its Lifecycle which could be used for future VO creation, knowledge about the customers and markets, inheritance and dissolving of shared resources (Jansson & Eschenbaecher, 2005). The VO collaboration management is identified by the ECOLEAD project as an area where further work is needed. It contains activities for managing and supporting the collaboration between different partners (Negretto et al., 2008).

VO Management Approaches

The fact that VOs operate in dynamic and changing environment make it difficult for participating partners to effectively manage it. Thus, different approaches were identified to manage the VO. *The first approach* is to manage a VO as a project using the Project Management Body of Knowledge (PMBOK) (Drissen-silva & Rabelo, 2008). PMBOK defined a project as a temporary endeavour undertaken to create a unique product or service which fits the VO's definition, but some researchers argue that the management of a VO is more complicated than that of a project even though some parts of managing them could be similar (Drissen-silva & Rabelo, 2008; Iris Karvonen et al., 2004). Although there are many similarities between projects and VOs, PMBOK lacks some of

the functionalities needed in dealing with VOs due to multiple organization participation, a complicated, long and previous preparation process for VO creation, no central authority in decision making, and its collaborative nature which requires continuous negotiation and discussion (Drissen-silva & Rabelo, 2008).

The second approach is using decision protocols and mechanisms for managing VOs. It focuses on defining a set of decision protocols to manage the VO during its Lifecycle to meet specific needs. Decision protocols mostly deal with the VO evolution phase by helping the VO manager in decision making and solving problems. The VO manager has to implement the necessary corrections as well as follow up information sharing and discussion among partners. This leave the VO manager with no guidelines or supporting methodology to help him in performing the required VO evolution activities (Drissen-silva & Rabelo, 2008).

The third approach is using project management reference models which include using different best practices and project management frameworks for the VO management. Management models such as Capabilities Maturity Model Integration (CMMI) and Agile Project Management (APM) can be used to support the VO management with some modifications and customizations to fit the VO environment. Other management models and frameworks include Engineering Change Management (ECM) and Configuration Control (CC) can be used as the basis for the VO evaluation management framework. These models provide components for problem identification, necessary change demand, change verification, analysis, approval and implementation (Drissen-silva & Rabelo, 2008). The problem of using this approach is that most of them were designed for projects, and they need to be customized to fit the VO's dynamic and changing environment where collaboration and decision making is needed to ensure the success.

The fourth approach is the collaborative discussions between different VO partners to globally coordinate their discussion, and integrate the flow of information and resources between them, which will give transparency to the whole process and regulate all partners' communication and involvement. It relies on computer support to enable the communication and discussion over the network between partners (Drissen-silva & Rabelo, 2008; I Karvonen, Jansson, & Salkari, 2004).

Obviously, none of the previously mentioned VOM approaches satisfy and address the VOM requirements and needs if it is used separately. A more effective and successful solution for the VOM is using a combination of the four mentioned approaches to address various aspects of the VO characteristics (Ashtiani, 2012). Therefore, in our research we refer to service management best practices the ITIL V3 and Engineering Change Management (ECM) as reference models with the ECOLEAD recommendations to support the VO change management activities. By providing a change process, change control, collaborative decision making and collaborative problem solving mechanism, the VO participating organizations will be able to initiate, assess, collaborate, authorize and implement the changes that they need in order to evolve successfully.

2.3 Service Oriented Architecture

Service Oriented Architecture (SOA) is an architectural style where systems consist of service users and service providers. It is an architecture that consists of different tools and technologies that support the rapid and faster implementation of services (Bianco, Kotermanski, & Merson, 2007). Building business applications using the SOA will increase the agility and the flexibility of business processes. Furthermore, it will increase the interoperability between various services and their reusability (Erl, 2005). According to Thomas Erl (2005), the SOA has different characteristics that provide more advantages to organizations who adopt this architecture. These include its *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. Furthermore, there are other advantages such as *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).

The SOA is defined from a business executive's point of view as a combination of services that can be exposed to customers and partners where business capabilities and logic can be recombined repeatedly to serve business needs on the long run. These services can be modified quickly in new business context allowing business to quickly

respond to customers' needs and requirements, business opportunities and market conditions (Holley & Arsanjani, 2010).

The SOA provides a proper way to create dynamic and collaborative applications that are built for change, because it is able to adapt 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 & Arsanjani, 2010). Using the SOA technologies such as Web Services, CORBA and Jini to implement the SOA architecture provides potential solutions for organizations to implement the service approach.

2.4 Change Management

Change management is a vast topic that involves different areas. Two general change management perspectives and areas of interests are: 1) organizational change management and, 2) information technology (technical) change management (Holley & Arsanjani, 2010). This research is primarily concerned about the technical aspect of the change management.

2.4.1 Organizational Change Management

Organizational change management includes the management of changes to the organizational culture, structure, physical environment, job design, responsibilities, staff skills, and knowledge and policies. Adopting the SOVO requires changes in the way applications are developed and the way IT and businesses communicate with each other. This requires an organization to investigate and assess different elements to manage and create cultural and behavioural changes necessary to fulfill overall strategic goals. These strategic goals made at the executive level, should define performance measures, efficiency, effectiveness, and SLA goals (Holley & Arsanjani, 2010).

In organizational change management, there are cultural and behavioural issues such as the sharing, funding, prioritizing, reuse, and ownership of services that need to be addressed (Holley & Arsanjani, 2010). The organizational change management includes different areas and requires someone with experience on how to transition the organization from its current state to its future state when adopting new strategies. While organizational change is not the focus of this research, it is important to differentiate it

from IT/technical change management to gain a better understanding of what a change entails.

2.4.2 Technical Change Management

According to Holley and Arsanjani (2010), change management from an IT perspective can be seen as a "process whereby changes to a service are formally introduced and approved before deployment into the next testing or production state." In this perspective, change management focuses on changes to a specific version of a service through its development Lifecycle, and ensures the prompt and efficient handling of all changes to business process and services through the use of standardized methods and procedures based on industry best practices (Holley & Arsanjani, 2010). The ITIL defines the goal of change management as "ensuring that standardized methods and procedures are used for efficient and prompt handling of all changes, in order to minimize the impact of change-related incidents upon service quality, and consequently to improve the day-to-day operations of the organization"(OGC, 2007b). In addition to this, according to Ola et al. (2008), change management has two main goals which are supporting the processing of changes, and enabling the traceability of changes. Change management is responsible for handling and managing the proposed changes to a service portfolio in a way that allows it to be carried out successfully while minimizing its impact on its environment.

Business processes and services in Service Oriented Virtual Organizations (SOVOs) are subject to changes in order to evolve and improve its operations and meet markets and customer requirements (S. Akram et al., 2010; Andrikopoulos et al., 2008). The process of change in the SOVO should be executed in a planned and organized approach to more effectively control the orchestration of the organizations. Organizations believe that virtual business models such as the SOVO has 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 & Rezgui, 2008). The fact that VOs operate in a highly changing and dynamic environment, it is thus critical for those organizations to facilitate the process of change in their business processes and services in less time and more effective ways as compared to their physical counterparts (Abuelmaatti & Rezgui, 2008).

In physical organizations, the process of managing changes during its Lifecycle is costly and can only be afforded by a few organizations. This leaves physical organizations with some limitations to evolve in a dynamic and changing market environment (M. S. Akram, 2005). Some of the limitations of physical organizations in managing changes as compared to the SOVO are illustrated in Table 2-3.

The process of managing changes in the SOVO becomes more complicated and complex as the number of services or service providers increases dramatically on the web (S. 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 the Information and communications Technologies (ICTs). A more practical and efficient way is to automate the process of change between different partners allowing a faster and a user transparent way of change management. This will allow a quicker response time for changes and less effort from the VO manager to track, maintain and coordinate for change (M. S. Akram, 2005).

Table 2-3: Comparison of the Physical Organization and the SOVO
(M. S. Akram, 2005; Drissen-silva & Rabelo, 2008)

Type of Organization	Internal structure	Coupling	Business entities Integration
Physical	Has a static internal structure with long term relationships between business entities. Changes to these business entities require more time, effort and money which make it difficult to adopt in a changing and very dynamic environment.	Have tight coupling entities with long term relationships. This makes physical organizations not as ready to quickly adapt to changes in its environment.	Integration between business units is known before the integration of the whole organization. It is a bottom-up approach, where each unit or department interacts with each other to form the organization's identity.
SOVO	Has a flexible structure with short term, temporary, goal-oriented and project-driven relationship among service providers. It has the potentials to operate in changing and dynamic environments by changing its business processes or services.	Have loose coupling business entities with goal oriented relation. This gives more flexibility to SOVO by allowing it to update or change its services to meet the market and customers' demands.	The integration between service providers or business units is determined after setting the goals and objectives of the SOVO. It uses a top-down approach in integrating business units to form their identity.

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 (M. V. Drissen-Silva & Rabelo, 2009). The unexpected events may lead to changes in the VO that require decision making, problem solving, discussion and collaboration between independent and autonomous partners (Drissen-silva & 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 (Y. Wang et al., 2010). The dependency between different business processes and services, in addition to; the complexity and the characteristics of the SOVO makes the process of change more challenging and complicated (S. Akram et al., 2010). Therefore, change management is an important research issue which needs to be investigated to enable organizations participating in the VO to go from the operation phase to the evolution phase allowing it to adapt to a dynamic and changing environment. The change management processes facilitate and coordinate business process and services changes between partners which eventually lead to faster VO change adoption.

2.4.3 Benefits of Facilitating the Process of Change in SOVO

The challenges that VOs face to adapt with the dynamic and changing environment can be minimized if the participated partners are able to find a mechanism or a way to allow their service and business process to evolve in a collaborative and efficient way (Drissen-silva & Rabelo, 2008). One way to guarantee a successful evolution is to have an efficient change management framework. VOs can offer potential and competitive advantage once the issue of change management is resolved (S. Akram et al., 2010).

Some of the benefits that the VO can gain if it was able to efficiently manage changes in its environment are growth, sustainability and stability, which result in more flexibility and competitive advantage. A VO consists of different organizations that work together to achieve the optimal goal by delivering value to their customers. Operating in a very dynamic and changing environment, and using ad hoc change mechanisms to react to changes are major obstacles for achieving VO's goals and objectives (M. S. Akram, 2005). A more agile, quick and predefine change management process is required in a VO environment, which allows it to provide the best services to its customers. Having a

quick response time and the agility through change processes allow the VO to grow continuously by reacting to the market requirements, which eventually increases the value added to their customers.

The fact that the number of service providers has increased rapidly over the web has left VOs with the challenge to maintain competitiveness in the market. All the VO members must constantly monitor changes in their environment and react to them in order to meet the market and customers' needs through improved services (Drissen-silva & Rabelo, 2008). Most the VO partners rely on the workflow Business Process Modeling and Notations (BPMN) and Business Process Execution Language (BPEL) to integrate their business processes together to create the final value or service to the customer. By having prior knowledge of change and predefined change processes, they can respond quickly and flexibly to market demands to remain profitable and competitive (Drissen-silva & Rabelo, 2008).

In order for the VO participants to evolve and improve their services to meet market and customers' demands, and react to the changing and dynamic environment, they need a framework that provides a supporting methodology to guild the VO participants in the process of change including change control, change collaboration, decision making and change automation. The following explains the ITSM and change management best practices and reference frameworks, which can be customized to fit the SOVO environment's change requirements.

2.4 Information Technology Infrastructure Library (ITIL v3)

The ITIL stands for the Information Technology Infrastructure Library, which is the most widely adopted approach for IT service management in the world (OGC, 2007a). Based on the experience of international public and private sectors, the ITIL provides a practical, no-nonsense framework for identifying, planning, delivering, and supporting IT services to businesses (OGC, 2007a). The ITIL offers a well-defined approach to the delivery of high quality IT services. The ITIL provides a detailed description on most of the important processes for an IT organization and provides specifications for tasks, procedures, and responsibilities that can be used as a reference for tailoring services to meet organization requirements and expectations (Jong et al., 2008, p. 9).

In the ITIL, a service is defined as “a means and a way to deliver value to customers by facilitating the outcomes that customers want to achieve without the ownership of specific costs and risks” (OGC, 2007a, p. 5). The basis of the ITIL v3 is the IT service management. Service management is a set of specialized organizational capabilities for providing value to customers in the form of a services (OGC, 2007a, p. 216).

The IT governance consists of a complete framework of structures, processes and relational mechanisms (Jong et al., 2008). The structures involve the presence of responsible functions and roles such as IT executives and accounts, and a diversity of IT Committees. The processes refer to strategic IT decision-making, changing and monitoring. The relational mechanisms include business and IT participation and partnerships, strategic dialogue and shared learning (Jong et al., 2008).

There are five phases in the ITIL v3 throughout the service management Lifecycle as illustrated in Figure 2-6. Each phase contains various components that are linked to each other in such a way that a change in a single component could have an impact on several other components. Each phase also has its own *processes* and *functions*.

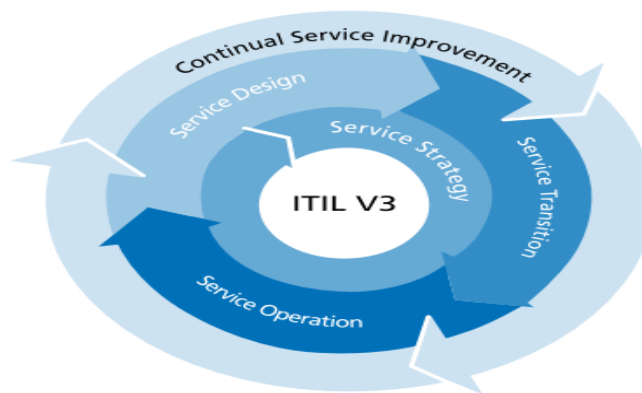


Figure 2-6: The ITIL Service Lifecycle
(Jong et al., 2008)

A process refers to a set of structured activities, which are designed to accomplish a defined goal. It has an input and output which result in a goal oriented change for enhancing and corrective actions, and can run through several organizational units (Jong et al., 2008). It is measurable, provide results to partners, customers or stakeholders and respond to a specific event in a continual and iterative way (Jong et al., 2008, p. 22). An

example of processes is the change management process. A process usually described by using procedure and work instructions. Procedures describe how and who execute certain activities. Work instructions define how one or more activities should be executed in details using technologies or any other resources (Jong et al., 2008; OGC, 2007a).

Functions are units of organizations such as a team or group of people and tools, which are responsible in carrying out processes and activities to reach specific results and outcomes (OGC, 2007a, p. 32). Functions define roles as well as their associated authority and responsibility for a specific performance (Jong et al., 2008). Functions have their own practices, their own knowledge body and can make use of various processes. An example of a function is a service desk.

The following is an overview explanation of the five phases of the service Lifecycle based on (Jong et al., 2008; OGC, 2007a, 2007b). For this research, more emphasis is given regarding service transition since this is where the change management process is defined and interacts with other management processes such as problem and configuration management.

2.4.1 Service Strategy

Service strategy helps clarify the relationships between various services and the business models, strategies or objectives they support (OGC, 2007a). The objectives of the service strategy are to identify what services to offer, how to differentiate ourselves from competitors, how to create value for customers, how to define and improve service quality, and how to efficiently allocate resources across a portfolio of services (Jong et al., 2008). The principles of service strategy include value creation, asset service, service provider types and service structure.

In service strategy, value creation is a combination of the effects of the utility and the warranty of a service, which are important and necessary for the creation of value for customers. The utility of a service refers to the offered functionality of a service to meet the customer's particular needs. Utility (fitness for purpose) summarized as what a service do (Jong et al., 2008). The warranty (fitness for use) is a guarantee that the service will meet its agreed requirements which include the availability, capacity,

continuity and information security necessary to meet the customers' requirements and expectations (Jong et al., 2008). According to Jong et al. (2008), the value network within service strategy phase can be defined as "a web of relationships that generate both tangible and intangible value through complex and dynamic exchanges between two or more organizations." Service Strategy processes include financial management process, demand management process and service portfolio management process where each process has its own objectives and activities (Jong et al., 2008).

2.4.2 Service Design

Service design phase deals with the design and development of services and different processes for the transition and production environment. It begins with the demand for new or changed requirements from customers to meet market demands, which require good preparation and the efficient infusion of people, processes, products and partners to ensure the success of this phase (Jong et al., 2008). It covers different aspects include: the design of service solutions; which is necessary to produce a new service based on agreed levels and requirements, the design of service portfolio; which describe the service delivery in term of value to the customers, the design of processes by defining the activities in the Lifecycle phases and identify the input and output which allowing the work to be more efficient and effective, the design of measurement systems and metrics where regular assessments of services quality performed to ensure the progress, fulfillment, efficiency and effectiveness of the services (OGC, 2007a).

Service design processes include service catalogue management process is to ensure that a service catalogue is produced, maintained and having accurate information on all operational services. Service level management process is to maintain and improve service quality where SLA and OLA is identified, monitored and agreed on between partners. Capacity management process is to ensure that the current and future capacity and performance aspects of business requirements are provided cost effectively (Jong et al., 2008). Availability management process is to ensure a service availability level is corresponds with the level as agreed with customers (Bon, Jong, & Kolthof, 2007).

2.4.3 Service Transition

Service transition phase is about aligning the new or changed services with the organizational requirements and operations. It refers to the management and coordination of processes, systems and functions required for the packaging, building, testing and deployment of a release into production, and establish the service based on customers, markets and stakeholders requirements (Jong et al., 2008). It supports the change process of the business, reduces variation in the performance and known errors of new or changed services, and ensures that services meet the service specifications. Service transition creates value to the business by improving the ability to adapt quickly to market and customer changes requirements, improving the success rate of changes and releases for an organization, improving the degree of compliance with organizational requirements during changes and having a clear plan to link organization change plans to transition plans (OGC, 2007a).

The service transition phase has different processes and activities which include:

- *Change management process* : The ITIL defines the goal of the CM as ‘the steps to ensure that standardized methods and procedures are used for efficient and prompt handling of all changes, in order to minimize the impact of change-related incidents upon service quality, and consequently to improve the day-to-day operations of the organization’. The CM is central to ensure the availability, reliability, and quality of IT services and processes. The ITIL identifies the key major activities, the roles and stakeholders that perform them and artifacts that are either consumed or produced by the various steps in the change management process (Jong et al., 2008; Keller, 2005). The CM process makes sure that all changes are approved, evaluated, prioritized, planned, tested, implemented and documented following standardized methods and procedures. Changes can be triggers for different reasons which could be pro-active or re-active reasons. Any request for change (RFC) needs to be analyzed by asking the seven R’s of the CM which are who *raised* the change? What is the *reason* for the change? What is the *return* required from the change? What are the change’s *risks*? What *resources* does it require? Who are *responsible* for building, testing and implementation? Which *relationships* exist between this and other changes? (Jong et al., 2008).

The process of change needs to go through specific activities to manage changes as illustrated in Figure 2-7 which are:

1. **Create and record:** creating, submitting and registering a unique RFC
2. **Review the RFC:** verifying if the RFC is illogical, incomplete or unfeasible.
3. **Assess and evaluate changes:** use the impact, risk assessment, benefits and costs of the change to determine whether a change is implemented or not.
4. **Authorization:** obtain formal authorization for the change.
5. **Coordinate implementation:** forward approved changes to the relevant product experts where they can build and test the changes, and create and deploy releases.
6. **Evaluate and close:** implemented changes will be evaluated, performing Post-Implementation Review (PIR) and change request closed if succeeded.

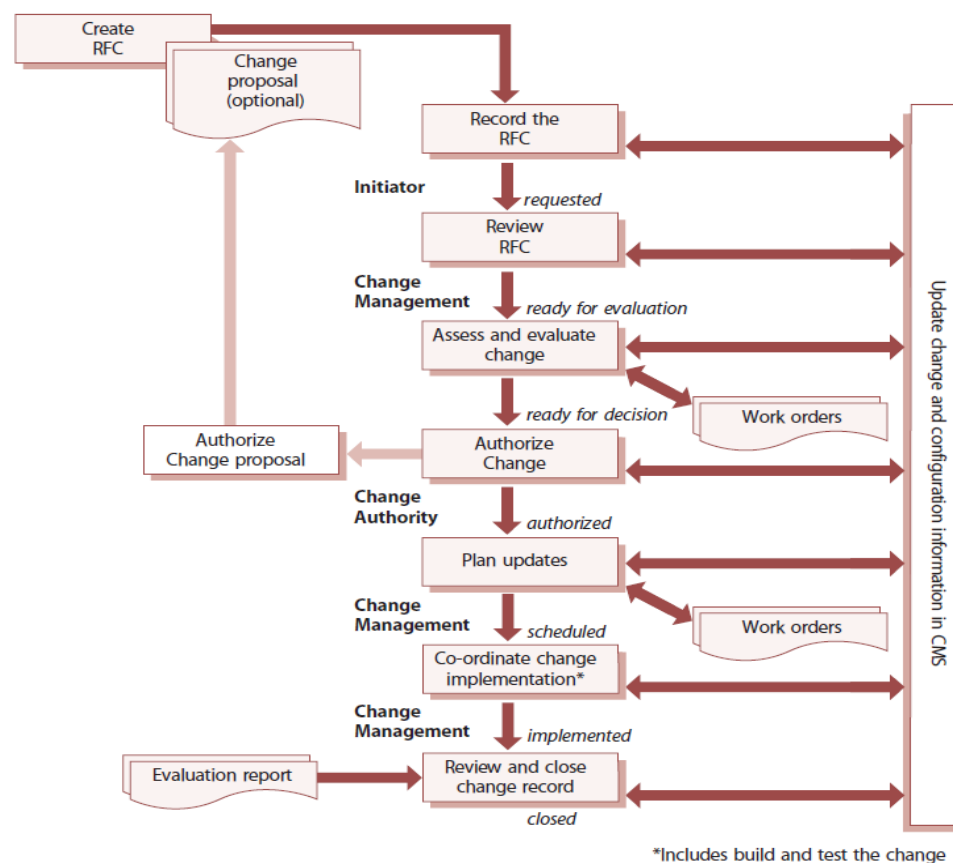


Figure 2-7: Process Flow of a Change Request
(OGC, 2007a)

- *Knowledge management process* which helps the management committee to improve the quality of decision making by making sure that reliable, efficient and safe information is available during the service Lifecycle. The primary purpose of the

knowledge management process is to improve efficiency by minimizing and reducing the need to rediscover knowledge, and make knowledge available whenever it is needed (Bon et al., 2007). Knowledge should be identified, captured and maintained effectively to improve the quality of decision making.

- *Service Asset and Configuration Management process* manage the service assets and configuration Items (CIs) in order to support the effective and efficient management of the IT organization. It gathers information about different service components, and how they relate to each other which will help in providing details impact and risk analysis. In order to manage large and complex IT services and infrastructures a configuration management system (CMS) is needed (OGC, 2007a).
- *Release and deployment management process* is to deploy new releases into the production environment enabling the effective use of the service which result in delivering the right value to customers (Jong et al., 2008).
- *Service validation and testing process* is to ensure that the new or changed service will add value to the organization by fitting the purpose, fitting the use and meeting customer expectations (Jong et al., 2008).
- *Evaluation process* is for verifying if the performance of the provided services meets the acceptance criteria based on the previously identified KPIs. Change management receives an evaluation report which indicates the performance, risks, qualification and recommendations about the changed services.

2.4.4 Service Operation

Service operation phase is to coordinate and carry out activities in an effective and efficient manner to provide and manage services to meet business and customer service level agreements. It is responsible for ongoing management of the technology used in providing the services, provides stable service, execution of processes and services and achieving service excellence. In this phase, the continual cycle of monitoring, reporting and taking actions is important in providing, supporting and improving services. During the monitoring process an operational faults maybe detected which will trigger an event that need to be resolved (Jong et al., 2008).

Service operation processes include: event management process, which provides capabilities to detect interpret and initiate appropriate action in respond for an event. Incident management process is to restore failures of service as quickly as possible with minimum impact on the business. Problem management process includes all the activities needed to diagnose the root cause of an incident, determine the resolution to the problem and ensure the right implementation of the resolution through change management processes and procedures (Bon et al., 2007).

2.4.5 Continual Service Improvement

It is to support continual improvement of the effectiveness and efficiency of the provided services to meet the business goals and objectives. It measures and analyzes service level achievements, recommend improvements in all phases, and introduces activities that will increase quality, efficiency, effectiveness and customers satisfaction (Jong et al., 2008). This involve the use of the 7-step improvement process that decide what should be measure, what can be measure, collects data, process the data, analyzes the data, provides recommendations, and implements those recommendations.

2.5 Engineering Change Management (ECM)

Today's dynamic markets and customers oriented environment make engineering change unavoidable by forcing manufacturing and suppliers to adopt and deal with the request of change by have a coordinated and organized change reference processes. Engineering change has grown steadily as an important issue for industry, and as an active academic research area (Jarratt, Eckert, Caldwell, & Clarkson, 2011).

Engineering change management (ECM) can be defined as “a coordinated management and uniform tracking of changes, i.e. collecting ideas or need for product and product related changes, elaborating one or more possible solutions, evaluating them with respect to technical and cost aspects and implementing them with respect to engineering and manufacturing (SASIG, 2009)”. The ECM provides an overall reference process which provides different activities and recommendations to support the process of change throughout the Lifecycle of engineering products (Jarratt et al., 2011).

2.5.1 ECM VDA4965 Reference Process

The Verband der Automobilindustrie (VDA) 4965 reference process is based on the requirements and experiences of the partners in the joint Strategic Automotive product data Standards Industry Group publication (SASIG) ECM workgroup. This recommendation has been validated by means of pilot projects in the companies involved (SASIG, 2009). The VDA ECM Reference Process is overall processes which consist of sub-processes which include:

- Engineering Change Request process (ECR) specification and Decision on Change which is a request to determine the impact of a change, the feasibility, the affected partners, the comments and assessments by experts or committees concerning costs, dates, quality, preparation time, and finally making a decision by accepting or rejecting the change.
- Engineering Change Order process (ECO) engineering implementation of change which is a request to implement an engineering change, consisting of its planning, design, acceptance, testing and documentation usually after the approval of change request.

The ECM Reference Process focuses on the development of alternative solutions, specification and decision on a change (ECR), the engineering implementation of change (ECO) and the implementation of the change. Figure 2-8 illustrates the ECM reference processes.

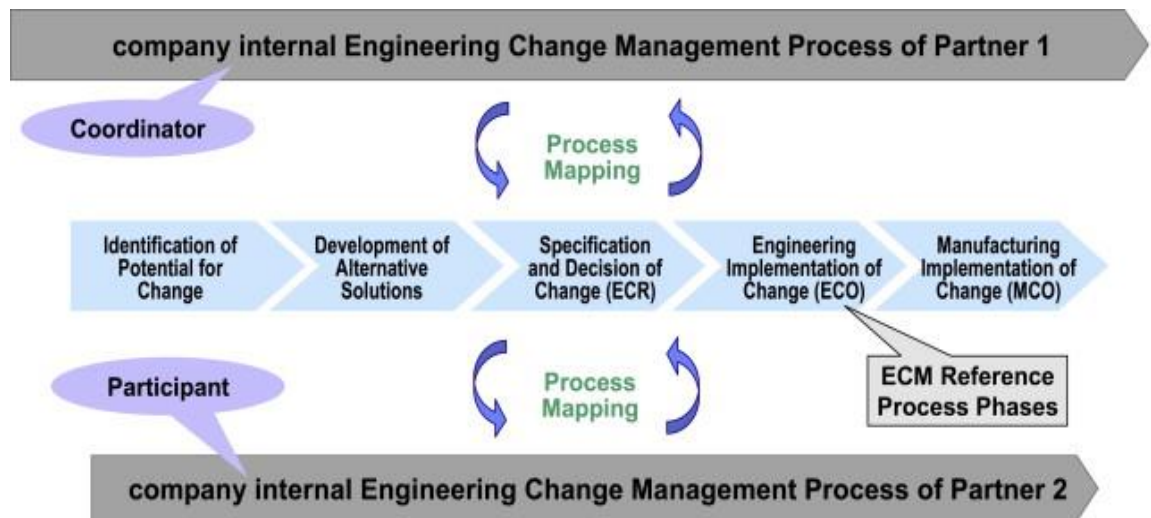


Figure 2-8: The ECM Reference Process partner model
(SASIG, 2009)

The VDA recommendations and reference process for the ECM enable change collaboration between distributed partners by synchronization of the various private ECM processes of partners using the ECM reference sub-processes, and defined exchange of messages. By reducing the complexity to a simple set of rules governing the relationship between a coordinator and a participant in the ECM Reference Process, it becomes possible to use the IT solutions to support deeply collaborative networks between manufacturers and suppliers without the need to have independent solutions for each collaboration relationship. The content of each message; which was embedded in the ECM reference sub-processes, during the communication with a partner enhance the transparency of the coordination and decision processes (SASIG, 2009).

2.5.2 Generic ECM Reference Process

A generic engineering change processes identified by Jarratt et al. (2011) in six steps as illustrated in Figure 2-9. The first step is to raise an ECR where organizations usually have a standard form for raising the request of change (RFC). The reason for the change, the priority of the change, type of change, and the affected components must be outline by the person who raised the change request. The RFC will be sent to the change coordinator who will handle the request. The second step is to identify potential solutions usually a single solution will be examined due to time pressures. The third step is to evaluate the risk and impact of each provided solutions from a different prospective.

Once a solution is identified and evaluated, the request has to be either approved or rejected by an engineering change board or committee. After approval, the selected solution will be implemented on a specific time. Finally, the implemented change should be reviewed after a period of time to see if it achieved the expected goals and what lessons can be learned for future change process (Jarratt et al., 2011). There are possible iterations during executing the process of change. For example, if the identified solution is too risky to be implemented, the process of change will return back to step two where other possible solutions can be identified. Another iteration can happen at the change board approval step, which requires the process to go back to step three.

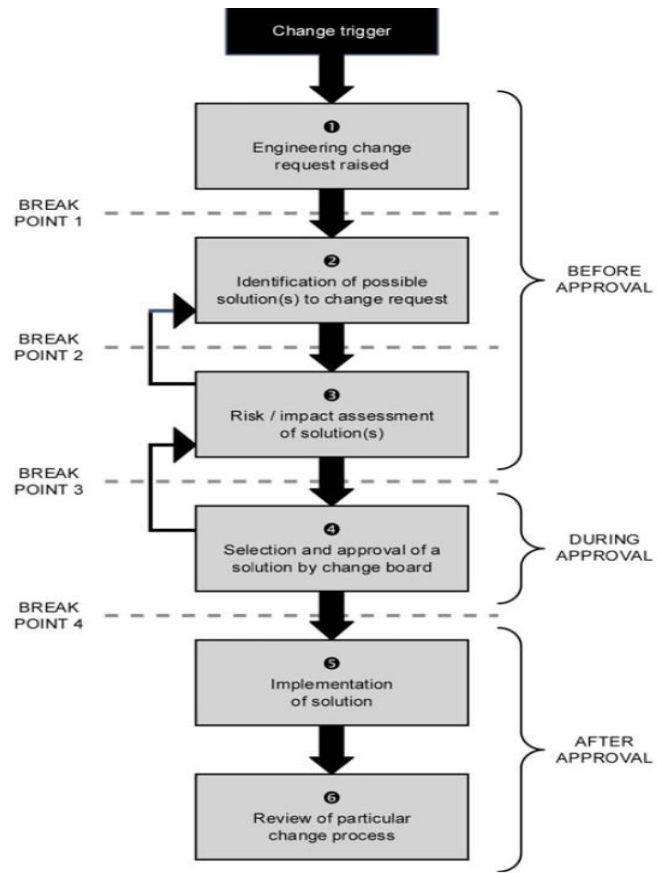


Figure 2-9: Generic Engineering Change Process
(Jarratt et al., 2011)

Chapter 3 : Proposed SOVO CM Framework

In this chapter, we propose a framework for Change Management (CM) in Service Oriented Virtual Organizations (SOVO). The propose CM framework includes a *structural* and a *procedural* framework. In the structural framework, different levels and triggers of change are identified in the SOVO environment. The Change Management procedural framework provides methods for efficient handling of changes based on the ITIL v3, Engineering Change Management (ECM), and the ECOLEAD best practices and recommendations. We first introduce the notion of SOVO and its three layers, which model the SOVO operations and collaborations. Then, we describe the change management propose solutions, which include our proposed structural and procedural frameworks.

3.1 Service Oriented Virtual Organization

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 allows businesses from different locations to share information and different resources to increase collaboration and provide more services to meet customers and market demands (S. Akram et al., 2010). The idea of aligning VOs with the SOA is potentially one of the best ways to implement and manage dynamic business processes to achieve the concept of a service oriented virtual organization (M. H. Danesh et al., 2011).

In the SOVO, several service providers try to address a business opportunity by composing their services to create a new service in order to provide an added value to the customers. The combination of the SOA and the Business Process Management (BPM) enable dynamic creation and evolution of VOs, and facilitate and support a faster path to the IT and business alignment, when it is supported by appropriate management and governance activities. A VO partner can publish his business processes as service where it can be composed with different services to create an added value service to customers. The operations and collaborations of the SOVO partners are modeled in three layers,

which are the value network layer, collaborative processes layer and service providers' layer.

3.1.1 Value network layer

The value network layer is the starting point for the SOVO business process designing and engineering. The value network can be defined as a set of roles and interactions which will generate a specific kind of business, economic or social good. It serves as a human-centric, and role-based network view of business activities (Allee & Schwabe, 2011). 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 & Schikuta, 2010).

The e3value ontology is considered in our research to conceptualize and model the VO in the value network layer. It provides modeling constructs for representing and analyzing a network of organizations, which exchange objects of economic value with each other (Kort & Gordijn, 2008). Figure 3-1 illustrates the use of e3value ontology to model the value exchange between different enterprises. Appendix C provides an explanation of the e3value ontological constructs by describing each component, which has been used in the SOVO value network layer representations.

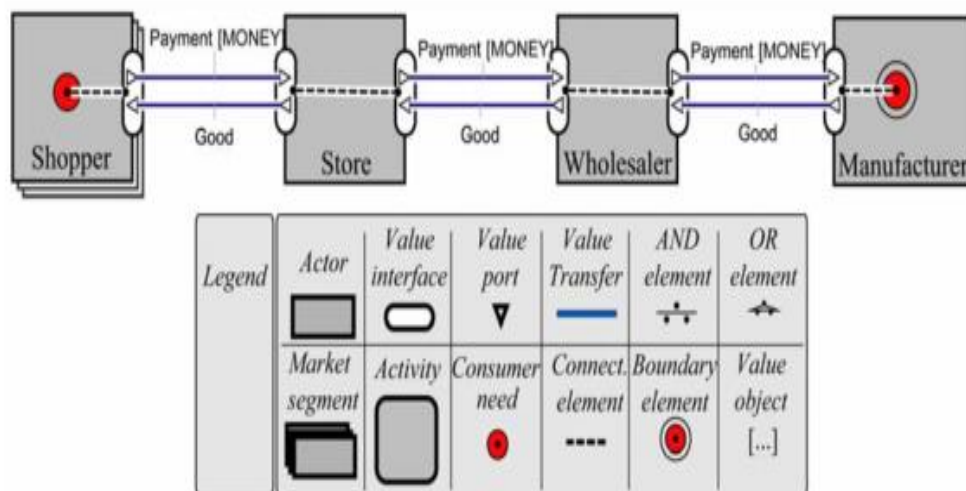


Figure 3-1: The e3value ontology modelling the value exchange
(Kort & Gordijn, 2008)

3.1.2 Collaborative processes layer

Collaboration is one of the characteristic which differentiate VOs from physical organizations. The collaborative process layer shows and demonstrates the collaboration between different actors (The VO partners) to achieve the purpose of the VO. A collaboration between partners can be done by exchanging information, sharing resources, risks, responsibilities, and rewards each of which contributes to enhancing each other's capacity to achieve the purpose of the VO. Collaboration is a relationship in which each participated organization wants to help its partners become the best at what they do which needs substantial time commitment, very high level of trust and extensive areas of common turf (Himmelman, 2002).

The collaborative processes in this layer are modelled using the service choreography. The choreography formalizes the way participated organizations coordinate their interactions, and exchange the information between each other (Object Management Group, 2011). It specifies each partner's role, activities and the sequences of service invocation. Figure 3-2 illustrates a sample of choreography modelling (the BPMN 2.0) which is used to model the collaboration in collaborative process layers.

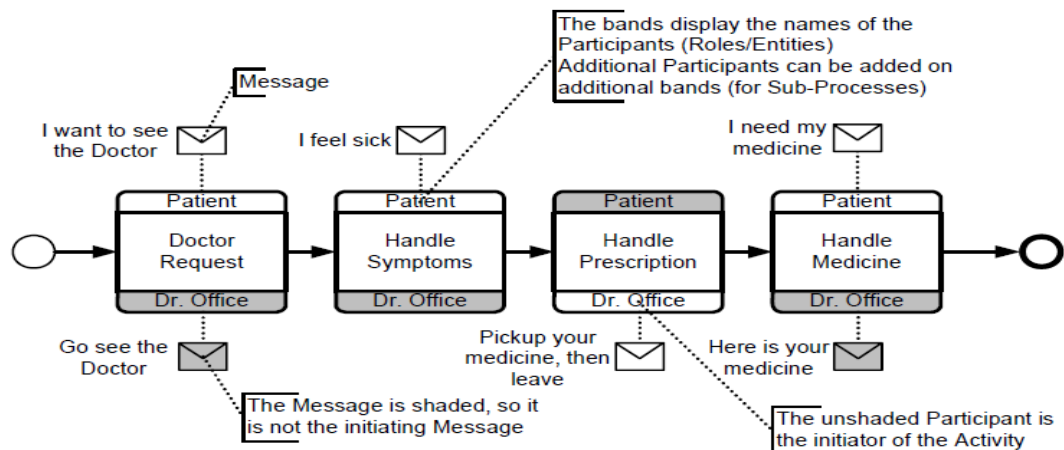


Figure 3-2: An Example of Service Choreography
(Object Management Group, 2011)

3.1.3 Service Providers' layer

The service providers' layer demonstrates the layer where the business partners provide their business processes as a service to satisfy the agreements of collaboration in the SOVO. The VO business partners provide their public services to be shared in a virtual hub. These shared services orchestrated to meet the overall VO choreography (Kamali,

2013). The service orchestration shows the service sequence and the workflow of the VO processes. In the service providers' layer, we use the standard BPMN to model partners' shared services, and come up with final partners' processes before the collaborative part. Figure 3-3 illustrates a standard BPMN for a supplier, which can be published as a service.

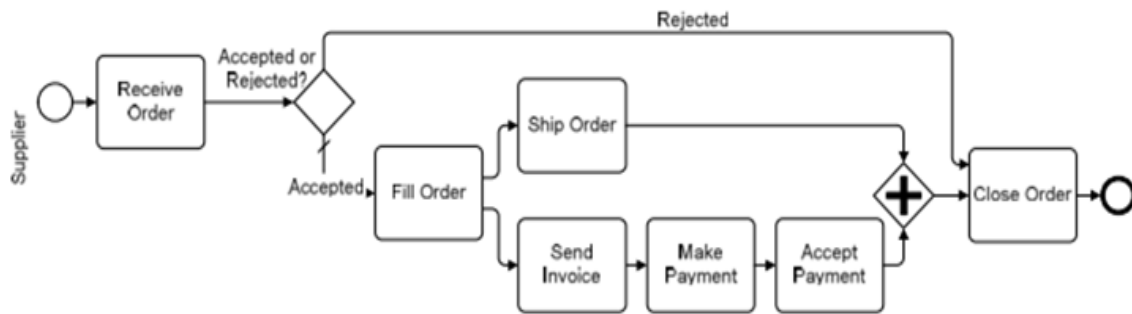


Figure 3-3: Example of Supplier BPMN

Understanding the three layers of the SOVO is important for understanding how to react to the changes, and identifying the level and impact of changes in each layer. Changes in the SOVO can be triggered by various reasons in the SOVO environment. When a change happens, an effective mechanism must be provided to identify the type, and the impact of the change to the VO. Understanding the impact and the reason of change is needed to determine how this change affects the entire VO. Determining the change impact provides an understanding of the change effects including the direct and cascading changes to the VO operation and collaboration. Determining and identifying the reasons and the triggers of changes will help the VO in reacting to the future changes.

Services and business processes in the SOVO may need to evolve frequently to meet the changing requirements arising from various origins. This requires techniques for enabling consistent modifications of the SOVO operations and collaborations. The following is our proposed change management framework, including the *structural* and the *procedural* framework to facilitate the process of changes in the SOVO.

3.2 Change Management Structural Framework

Service Oriented Virtual Organizations has three layers, which modelled the operations and collaborations between the VO participating organizations. If a change needs to be

done in the SOVO, the three layers of the SOVO will be affected by this change. The proposed structural framework categorizes changes in the SOVO into three layers of change, and identifies the impact of change on each layer. Furthermore, it identifies different reasons which eventually lead to changes in the SOVO three layers.

3.2.1 Levels of changes

Changes in the SOVO could be triggered for different reasons and in different levels during the operation and the evolution 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 are dependable, related, and connected with each other, makes changes in the SOVO more complex. This complexity result in any change in one of the SOVO layers may propagate into changes into the other layers. In general, our propose solution classifies changes in the SOVO into:

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

Figure 3-5 illustrates the proposed level of changes in the SOVO with the impact on each layer.

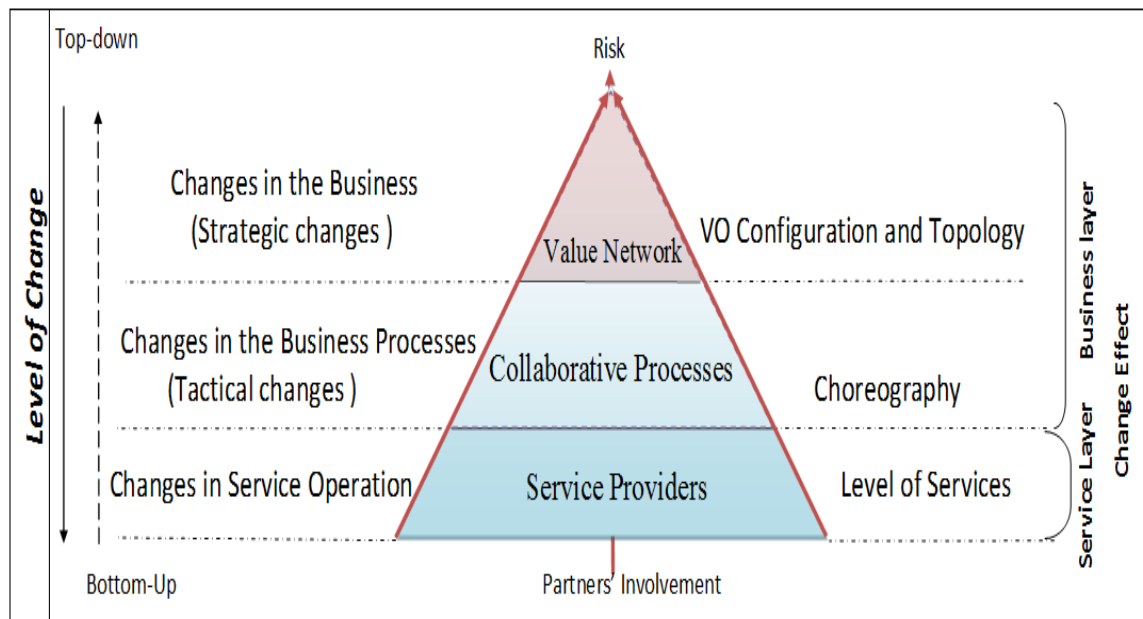


Figure 3-4: The SOVO CM Level of Changes

The bottom-up changes are low-level changes in the VO service layer. It includes changes in service operation, and will affect the level of services provided by partners. It may or may not propagate into high-level changes in the collaborative process layer or in the value network layer. An example of that could be upgrading a partner service for fixing errors or bugs. In this case, it is a low-level change (service providers' level), and it will not propagate to higher levels of change since the upgrading will not affect the way the service functions and operates. In another case, if upgrading the service will affect the way that service works (for example, new require parameters to operate); this will propagate to higher levels of change in the business layer.

The top-down changes are high-level changes in the VO, which include tactical and strategic changes in the VO business layer. Business strategic changes require decision making to decide when and what to do regarding a certain problem. Business tactical changes are easier to fix than strategic changes requiring us to choose how to do something rather than what to do. Strategic changes investigate what to do with the resources to build and grow the VO whereas tactic changes are about everyday actions to achieve the VO goals. Top-down changes will start from strategic business requirements and it will propagate into tactical and lower level changes. Business layer changes include changes in the value network level (strategic changes) and changes in the collaborative process level (tactical changes).

Value network layer changes

Our propose solution identifies the value network changes as high-level changes in the business prospective, which affects the configuration and topology of the VO , and at some stage will question the feasibility of the VO itself. The value network can be defined as a set of roles and interactions which will generate a specific kind of business, economic or social good. It serves as a human-centric and role-based network view of any business activity (Allee & Schwabe, 2011). The value network focuses on a group of entities who work and collaborate together to achieve certain business goals. 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 different VO partners involved.

Changes in the value network level will affect the VO's operational configuration and topology. By changing the VO's operational configurations, we are referring to changes in the consortium of the legally independent organizations, their service contributions, value exchange and Service Level Agreement (SLA), which will affect the value added to this VO. In this level, 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. By changes in the VO topology, we mean a modification is 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 control (M. H. Danesh et al., 2011). Changes in the VO's managerial configuration and topology can be changed during the VO's operation and evaluation Lifecycle, but it is not related to changes in the value network since the value network demonstrates the way that participants can operate to achieve the VO goals and objectives.

Collaborative process layer changes

Collaborative process changes are high-level changes in the business processes, which will 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 (M. H. Danesh et al., 2011). The collaboration between different organizations in the SOVO is modeled using the service choreography, which focuses on collaboration and service interaction. It specifies each partner's role, activities and the sequences of service invocation. It also serves as a collaborative agreement between the VO business partners. Choreography is a complementary technique to service

orchestration by providing a large scope about all the involved partners and their associated interactions (Ola et al., 2008).

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 changes in the value network level (on the long-term it will) and require partners' negotiation and decision making. Furthermore, changes in the collaborative process level will propagate into lower level changes in the VO partners shared services.

Service providers' layer changes

Service providers' layer changes are low-level changes in the VO service layer, which will affect the level of the services provided by the VO partners. The VO partners can initiate changes to their private services without affecting the VO operations and collaborations. On the other hand, the VO partners can request a change to their VO shared services which affect the VO service providers' layer. Service providers can initiate functional and non-functional changes to their VO shared services.

Functional changes refer to 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 initiated by the service providers, and will affect the VO in the service providers' layer. Functional changes can be classified into structural and behavioural changes. Structural changes refer to changes in the operational aspect of the shared services. The behavioural changes refer to service providers' changes in the 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 (S. Akram et al., 2010).

Non-functional changes refer to changes that triggered from the VO partners' performance prospective. 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. For example, a service provider could request a change to the VO if he/she is not happy with

the reputation of one of the service providers working within the VO. Another example, if the privacy of the service provider has been compromised, he/she can request a change in the VO (service provider layer) where an agreement can be negotiated and may lead to high level of change.

Dealing with functional change is usually more challenging and requires some changes in the business level. Functional changes occur more frequent due to the VO dynamic business environment (Liu & Bouguettaya, 2007). The involvement of the VO partners in the process of change increase as we go from low-level changes to 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 go from low-level changes to high-level ones. If the VO participants are not able to collaborate to solve the problem effectively, the VO will eventually dissolve or may go to the metamorphosis stage. Metamorphosis is another stage of the VO Lifecycle which may come after the evaluation of the VO, where all VO partners have their own bag of assets and decide to start new VO relying on previous one. The new VO has major changes in the objectives, the principles and the membership that leads to a new form of organization with new purpose (Afsarmanesh, 2008).

3.2.2 Triggers of changes

The fact that the VO has distributed and independent partners, makes changes in the SOVO occurs 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 advisory board (CAB) members or even by the VO partners themselves. The need for change in the SOVO can be identified and recognized by different reasons, which lead to changes in the three levels of change identified earlier. Figure 3-6 illustrates different reasons which lead to a change in the VO different levels of change.



Figure 3-5: The SOVO CM Trigger of Change

Changes can be triggered automatically based on the pre-defined threshold set up and agreed upon between the VO participated partners. Measuring of key performance indicators (KPIs) using the Performance Management Framework and Tools, and mining the customers' feedback and needs will automatically trigger changes in the SOVO to satisfy the needs and expectations of the added value delivered to customers. On the other hand, changes could be triggered manually by CAB members or service providers; because of different reasons such as compliance with new regulations or new business strategies, though submitting a request for change (RFC). The triggers of change in the SOVO can be internal or external triggers. Internal triggers refer to changes that initiated from within the VO. For example, Performance indicators consider as internal triggers of changes. External triggers refer to changes that initiated from outside the VO. For example, changes in the environment surrounding the VO or changing in the technology will force the VO to trigger changes. The following provide more details about triggers of change in the SOVO.

Performance Indicators (The SOVO Performance Management Framework)

Performance indicators in the SOVO are defined in the performance management framework in three layers as illustrated in Figure 3-7. Each level has its own key performance indicators (KPIs) to measure the performance of operation at that level. The VO performance management framework identified all the performance measurement criteria and their threshold which eventually trigger a change in one of the three levels (Kamali, Richards, Danesh, & Raahemi, 2012).

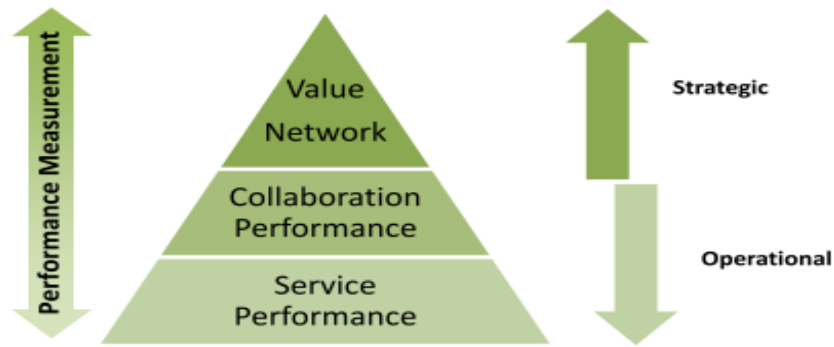


Figure 3-6: The SOVO Performance Indicators Pyramid
(Kamali et al., 2012)

Service Performance is the lowest layer of performance indicators in the VO to fulfill given tasks and contribute performance of the partners. These performance indicators are used to assess the effectiveness and efficiency of services shared by a specific partner in a collaborative process (Kamali et al., 2012). The threshold for the KPIs is agreed and documented in the SLA between partners. The pre-defined Key performance indicators in the service level are illustrated in Table 3-2.

Table 3-1: The SOVO Service Performance Indicator
(Kamali et al., 2012)

Dimension	Indicator	Description
Availability	Service availability	The percentage of times that a service is available to be invoked.
Responsiveness	Response time	The average time it takes for a service invocation to be responded.
Reliability	Service Breaks	One time a service is out of availability is one break.
	Cost Measures	Cost of the production of goods, or delivery of business services.
	Quality Measures	Quality of the product or service.
	Quantity Measures	Quantity of the product or service.
	Time Measures	Duration of the production of goods, or delivery of business services.

Measuring the performance of the partners' collaboration is essential to the successful management of the VO to be able to deliver its objectives (L. Camarinha-Matos & Afsarmanesh, 2007; L. M. Camarinha-Matos et al., 2008). The indicators in the performance collaboration layer are necessary to assess the effectiveness and efficiency of how partners will work with each other (Kamali et al., 2012). The performance indicators in this layer play a major role in the coordination between the VO partners and the success of their alliance. The KPIs in the collaborative process layer are defined to

include the SOVO different entities (VO, partner, Collaborative Process and Services). Figure 3-8 illustrates the defined collaborative process level KPIs mapped on the Entity Relationship Diagram (ERD). Discussing the details of the KPIs is out of our research scope more details discussed in (Kamali, 2013).

The value network performance indicators in first layer have the strongest ties to the SOVO's strategy since it requires decision making and negotiation between partners. Value network KPIs measure the level of efficiency and effectiveness of creating value for the customers (Kamali, 2013). The frequency of change in the value network layer is not as much as in the service and collaborative process layers.

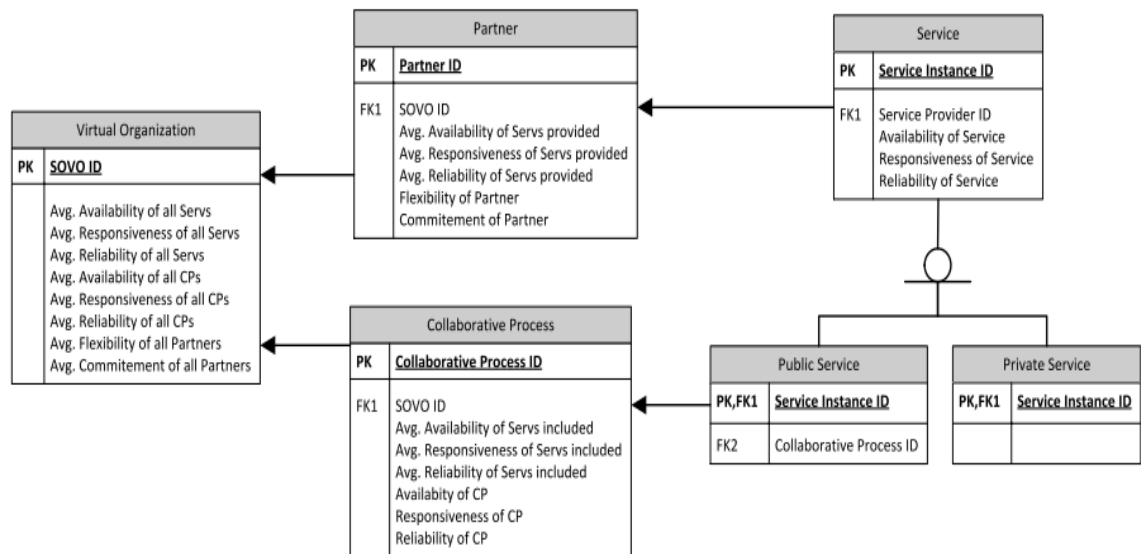


Figure 3-7: The ERD of SOVO KPIs
(Kamali, 2013)

Customers Feedback and Needs

Customer feedback and needs can automatically trigger a change based on the feedback, needs and anticipation of the VO customers. The final product or service that the VO produce and deliver should meet the customers' needs and expectations; so if the customer was not satisfied with the level of services or the final product, a change will be required to meet the customers' expectations and satisfaction. Receiving the customers' feedback and needs measure the external performance of the VO and anticipate future improvements in the VO services.

The VO customers provide their feedback and reviews regarding the services provided by the VO. The reviews provided by customers refer to certain problems which they are facing during the operating, ordering or delivering the service or product. By categorizing customers' feedback and using a predefined threshold, if customers' negative feedback goes beyond the threshold an event will be triggered. The trigger will alert the CAB members to investigate the problem, which may lead to changes in the VO. This trigger of change is an external trigger based on customers' satisfactions and needs.

Business Strategies

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 operate in forcing it to adopt new strategies to achieve sustainable competitive advantage. The VO CAB members or the VO coordinator 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. The VO CAB members may trigger a change in the VO to add more value to the VO by adding a new service provider to the existing VO service providers. This is an internal trigger of change seeking new opportunities and value. Furthermore, the VO CAB members may force to trigger a change in the VO to comply new government regulations such as restricting the VO operations to specific areas and deals with specific service providers. This is an external trigger of change, which comes from the environment surrounding the VO.

The VO Service Providers (Partners)

Service Providers can manually trigger changes to their shared services in the VO for functional or non-functional changes. Functional changes refer to those that trigger changes on the functionalities of the VO. Non-functional changes refer to those that trigger changes from a partner's performance prospective such as partner reputation or privacy. 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 a change to update his service, which is being shared in the VO; by adding new functionality or modify the properties of that service. For example, a service provider may trigger a change to modify the web service description (WSDL). This is a functional change which will relate to the VO functionality. On the other hand, from the service provider performance perspective (not the VO performance) a service provider can trigger a change. For example, the reputation of one of the VO partners forces another service provider not to collaborate or work with them in the VO. So, this will trigger a change which may lead to withdraw the service provider from the VO voluntarily.

Table 3-3 illustrates the different triggers of change and their types supported by examples of changes.

Table 3-2: Examples of the SOVO change triggers

Trigger of change	Type	Example
Performance Indicators KPIs	Internal (Automatic)	If the availability of a service provider goes beyond the agreed threshold, it will trigger an event by alerting the CAB members. This problem needs to be investigated by identifying the root cause of the problem. A possible solution could be changing the responsible service provider with a new one who is able to meet the agreed level of availability. An RFC will be triggered to go through the change processes in the VO which will need collaboration and decision making.
Customer feedback and needs	External (Automatic)	If the customer satisfaction feedback regarding the quality of the service provided by the VO became out of the threshold, an event will be trigger alerting the CAB members. The change manager and CAB members will identify the root cause of this dissatisfaction. After identifying the root cause, a change process will be initiated to solve this problem.
Business Strategy	External &	The CAB members may initiate changes to add more values to their customers by adding separate financial or shipping services to the VO

	Internal (Manual)	by adding a new service provider to the VO. To comply with the government regulations, CAB members may initiate changes to restrict the VO operations in certain countries.
Service Providers	External (Manual)	A service provider can trigger changes in the VO (shared service) to change the WSDL file that describes the service and it is calling ways or to update an old service with a new one that require new parameters as input.

3.3 Change Management Procedural Framework

Change management is a procedural based process which starts with the detections of a change trigger and ends up with the implementation of the new change within the VO. Service Oriented Virtual Organizations (SOVO) can initiate changes in the three levels of change for different reasons during the operations and evolution of the VO. Managing changes in such complicated business environment with distributed partners manually is not practical. A more practical and efficient way is to have automated or semi-automated process of change, which engages all the VO participating organizations in the process of change. This will allow a quicker response time for change, less effort from the VO change manager to track, maintain and coordinate for change and more user transparent ways of change management.

The proposed change management procedural framework is derived from the ITIL V3, the ECM and the ECOLEAD best practices and recommendations. Figure 3-9 shows the procedural framework, its different components, information flow and communication between different entities. The proposed procedural framework components include:

- The Six layers of change processes this includes:
 - Change Initiation layer.
 - Change Identification and Assessment layer.
 - Change Communication and Collaboration layer.
 - Change Planning and Authorization layer.
 - Change Coordination and Implementation layer.
 - Change Evaluation and Closure layer.

- Change management different actors and participants this include:
 - The VO change manager.
 - The VO coordinator.
 - The change initiator.
 - The VO affected partners.
 - The change authority (CA).
 - The CAB members.

- Change control requirements: in order to ensure that all changes in the VO are controlled by submission, recording, analyzing, assessing, decision making and approval, some components need to be identified especially in the VO environment. These components include:
 - The role and responsibly of each participant in the process of change.
 - The CAB members' composition and selection.
 - The Request for Change (RFC) specifications and details.
 - The level of change authorization.
 - The relationship with process.
 - Change escalations.

- Related management processes has interface with change management include:
 - SOVO Process Management.
 - SOVO Performance Management.
 - SOVO Knowledge Management.
 - SOVO Problem Management.
 - SOVO Configuration Management.
 - SOVO Release Management.

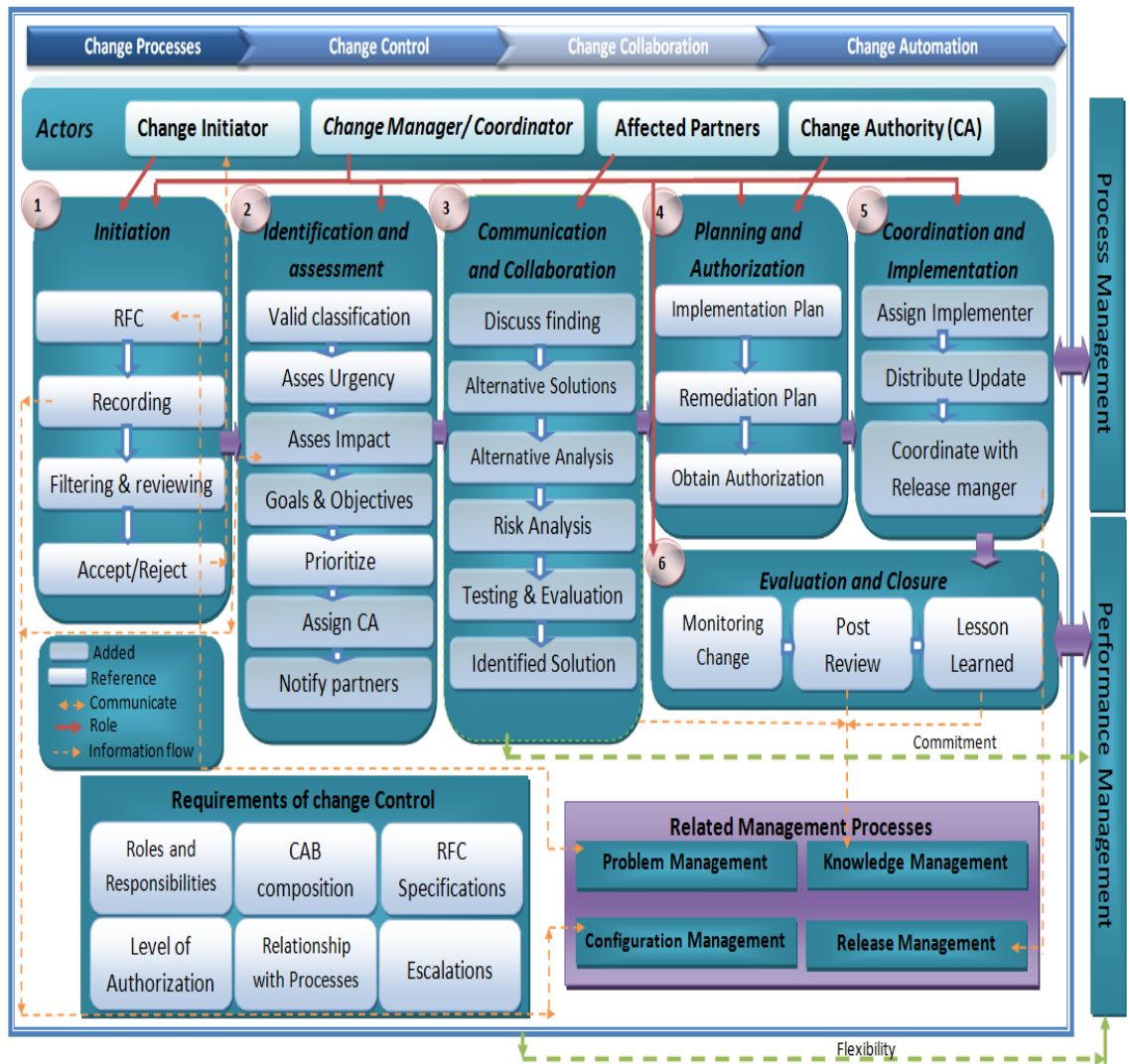


Figure 3-8: The Proposed Change Management Procedural Framework

3.3.1 Change Processes

The change management processes provide a sequence of steps or activities that the VO and its participated organizations can follow in initiating changes to their business processes or services. Figure 3-9 illustrates the six layers of the SOVO change processes, which the VO can follow to initiate, assess, collaborate, plan, authorize, implement and evaluate change.

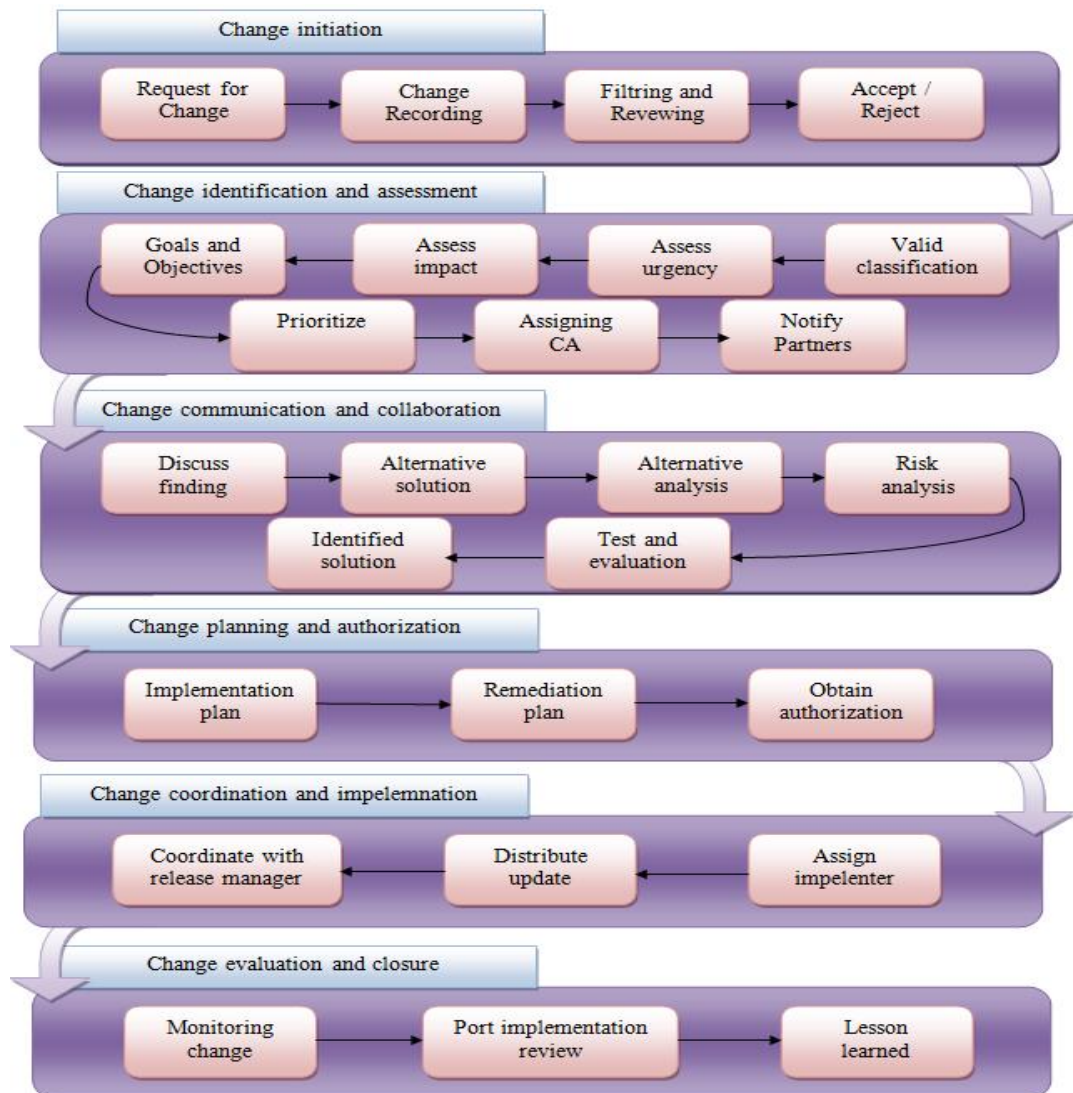


Figure 3-9: The SOVO six layers of change processes

The first layer of the change processes is Change Initiation; any change can be initiated through pre-communication between the VO coordinator and the change initiator which leads to Request for Change (RFC). Furthermore, a change initiator can trigger an RFC even without communicating with the VO coordinator. The RFC is usually initiated because of a problem that requires a change in one of the levels in the VO. In the RFC, the change initiator provides the required information according to the agreed RFC specifications. This information is needed to assess the RFC, investigate the problem and the proposed solution. The change initiator has the option to provide his/her initial solution of the problem. The request should be recorded, reviewed and filtered by the VO change manager. If any information is missing, the request will be returned back to the

initiator. The request will be accepted or maybe rejected if further information is needed or a proposal is required.

The second layer is change identification and assessment, the change manager collaborates with the change initiator to validate classification of the change, measure how long it will be until this change has a significant impact on the VO, measure the effect of this change in the VO business processes and its SLAs, identify the new Service Acceptance Criteria (SAC) which meets the VO goals and objectives, prioritize this change based on its impact and urgency. Afterward, a Change Authority (CA) should be assigned to handle the change authorization and implementation. If the change requires collaboration and decision making from the other VO participants, all affected partners in the process of change will be notified to collaborate and discuss this change. Table 3-4 illustrates the activities of this layer with a brief description of each activity.

Table 3-3: The identification and assessment activities

Activity	Description
Change classification	Any change can be classified based on the level of change where the change has started, this include value network change, collaborative processes change and service change.
Change urgency	The urgency of change is the extent to which a change can bear delay, which can be determined by the change initiator and the change manager. It can be high, medium or low urgency. Identifying the impact zone can help in determining the urgency of a change.
Impact of change	The impact of a change is the effect of change on the VO which can be determined based on the change classification: • High impact: value network changes affect the VO configuration and topology. • Medium impact: collaborative process changes affect the VO choreography. • Low impact: service changes affect the level of the service provided by a service provider.
Priority of change	The priority of change is how quickly the change should be presented and discussed by the VO. It provides an order in which change request is considered for authorization. The propriety of a change can be determined based on the impact and urgency of the change (Jong et al., 2008). Figure 3-11 illustrates

	our proposed method to identify the propriety of a change.
Assign change authority	The change authority authorizes changes to be performed based on assessment information in the change request. As in Figure 3-10, the change authority can be the CAB members or the change manager based on the level of change. The change manager can grant the authorization of a change to the change initiator in the low level changes.
Partners Notification	If the change requires collaboration and decision making between the VO partners, a notification will be sent to the affected partners where they collaborate in finding solutions for the problem.

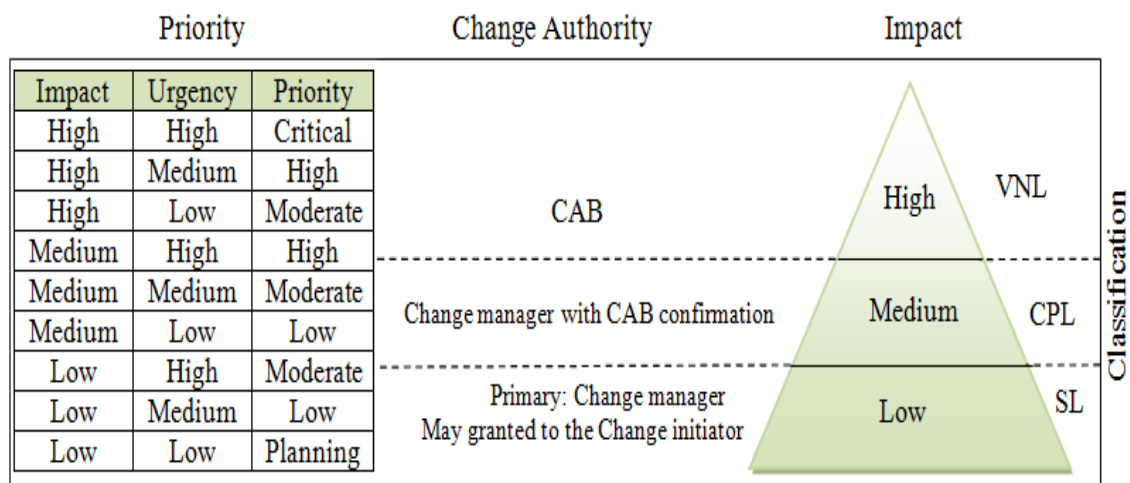


Figure 3-10: The identification and assessment procedures

The third layer is communication and collaboration where all affected partners collaborate to find a solution for the proposed problem keeping in mind the initial solution provided by the change initiator if there is. The VO affected partners collaborate with each other by discussing the change request, providing solutions, risk analysis, ways to test and evaluate their solutions before implementing it. Partners can discuss the problem in a collaborative environment using different kinds of collaboration ways before providing their final solutions. Details about the collaboration, communication and decision making tools used in the proposed solution discussed in section 3.3.3.

Based on the provided solutions from the VO affected partners, one solution will be identified and selected by voting. The voting percentages calculated in terms of the number of votes for each solution. The voting tool and the voting records will be maintained by the change manager. Voting members may choose to qualify their votes

with comments for the selected solution. Only the eligible voting members are able to engage in the voting process. The eligible voting members include:

- The VO change manager.
- The CAB members.
- The VO coordinator.
- An invited expert.

The change manager will select the most feasible solution with the higher percentage based on the voting members' selection. Table 3-4 provides an explanation of the collaboration and communication layer activities.

Table 3-4: communication and collaboration activities

Activity	Description
Discuss finding	The notified VO partners communicate with each using the social toolbar in the change management console or any other communication tools to discuss the proposed change and its impact of the VO.
Alternative solutions	Each affect partner provides his/her own solution for the emerging problem. The VO partners are committed to provide solutions to the problems facing the VO.
Alternative analysis	Based on the proposed solution, the VO partner provides more details which may convince the VO voting members about his/her proposed solution.
Risk and impact analysis	Identify the impact of implementing the change on the VO. This includes impact upon the level of change, the relationship with partners and customers, the VO business model and objectives.
Test and evaluate	Identify different test and evaluation scenarios which show if the proposed solution can be tested and evaluated before implementing it.
Identified solution	The VO voting members vote on the various proposed solutions using a voting tool. Based on their voting, a solution will be selected by the change manager.

The fourth layer is the planning and authorization, where a change implantation and remediation plans is developed, and the authorization of a change requested from the change authority (CA). In this layer, we have the change window which is the agreed

time when the change will be implemented with minimal impact on VO operations, the remediation or back-out plan in case something goes wrong during implementation. The change manager collaborates with the change initiator to develop the implementation plan which includes all the change details discussed earlier and the initial change schedule. No change should be authorized without having the answer of the question what to do if the change was not successful. That is why we need the remediation or back-out plan. A remediation plan is an approach the VO can follow if a change is not successful. This may involve backing out an installation, invoking continuity plans, or some other approaches. The remediation plan should be developed by the change manager and the change initiator before submitting the request for the change authority authorization. Based on the level of authorization, the change authority will assess the change details and take a decision if the change will be authorized or not.

The fifth layer is coordination and implementation where the VO coordinator will assign implementer to execute and follow the change in conjunction with the release manager. The release manager in the SOVO release management will be responsible to deploy the new change. A notification will be sent to all VO partners about the status of the change and the change window. This layer needs to consult the SOVO process management framework to facilitate the implementation process (M. H. Danesh et al., 2011).

The sixth layer is evaluation and closure. After implementing the proposed solutions and executing the changes by the release manager, the VO needs to evaluate and monitor the implemented change using the performance management framework to ensure that risk have been managed and the new modification meet the requirements identified in the implementation plan. Post-implementation Review (PIR) document needs to be developed by the change manager and presented to the CAB members. It indicates if the change was successful and identifies the opportunities for improvements. The change manager should identify the lessons learned during the process of change which should be stored along with PIR in the SOVO knowledge management (KM) repositories.

Appendix A shows the flow chart of change management process in the SOVO.

3.3.2 Change Control

There are important components that need to be considered to ensure flexible and controlled change management processes and procedures which include:

- The Roles and Responsibility.
- The CAB Composition.
- The RFC Specifications.
- The Level of Authority.
- The Relationship with other Processes.
- The Escalation Process.

The roles and responsibilities of participants in the process of change should be identified earlier. A list of the roles and responsibilities of each participant in the process of change in the SOVO is provided in Table 3-5. Furthermore, the responsibility matrix (RM RACI) can be used to identify the Responsible, Consulted, Accountable and Informed participants in the process of change activities (OGC, 2007b) .

- Responsible: the person who is responsible for completing a change task.
- Accountable: the person who is ultimately answerable for a change task.
- Consulted: the person who gives advice regarding change task.
- Informed: people who must be kept informed regarding a change status.

Table 3-5: Roles and Responsibilities in Change Processes

Change Management Process Roles and Responsibilities	
The VO Change manager	• Receive RFC's and ensure that they are properly recorded. • Assess, filter, review and classify all RFCs. • Conduct RFC impact analyses and risk assessments of changes. • Prepare CAB discussion and meeting. • Provide all necessary review information to the CAB members. • Chair CAB meetings. • Analyze, prioritize, and classify RFCs. • Provide a change notification to change initiator and other affected partners upon rejection, acceptance, collaboration or implementation.

	• Monitor the progress of changes. • Monitor the completion of all RFCs to ensure that the implementation meet the expectations. • Chair Post Implementation Reviews (PIR) and lesson learned. • Review and evaluate the change process. • Vote on the proposed solutions. • Request CAB confirmation to authorize high level changes. • Authorize low level changes. • Grant authorization to change initiator.
Change advisory board (CAB)	• Vote on the proposed solutions. • Authorize and confirm high level changes. • Assess proposed high level changes. • Help assessing the urgency of change. • Give advice concerning the risk of implementing a change. • Collaborate with the change manager if needed. • Oversees the overall change process. • Monitoring the VO performance.
The VO coordinator	• Select and compose the VO CAB members. • Select the VO change manager. • Handling the escalated changes. • Report the VO manager. • Vote on the proposed solutions. • Assisting the change manager if needed. • Ensure consistency between the different SOVO management processes.
The VO partners	• Collaborate with the VO change manager when needed. • Committed to provide solutions for the proposed problems during the change processes. This includes the re-active and pro-active commitment.
Change initiator	• Initiate an RFC. • Provide change details to the Change Manager for updating the RFC. • Collaborate with the change manager when needed during the raising RFC.

	• Follow processes for submitting a Request for Change (RFC), including reference to any applicable problem records or configuration items.
An invited Expert	• Provides consultation regarding emerging problems. • Vote on the proposed solutions.

In the CAB members' composition component, the CAB members are composed during the creation phase of the VO by the VO coordinator. CAB is a governing body that organized to support in the authorization, assessment, collaboration and decision making of a change. The CAB members should be chosen from different partners who are able to deal with both business and technical prospective of change. Each VO business partner has a representative in the CAB, and the VO change manager is the chair of the CAB. The CAB members can trigger changes in the VO environment for different reasons.

The RFC specification component identifies the required information that is needed to include in every submitted change request. The RFC specification should be identified and defined by the VO change manager. The ITIL V3 provides a list of all the required parameters which can be customized to be used in initiating a change request in the SOVO.

Level of authorization component identifies different levels of authorization linking to the level and impact of a change. The VO change manager along with CAB members will be responsible to identify the level of authorization. The level of authorization indicates who is responsible to authorize changes in each one of the three levels of change. For example, low level changes do not require the CAB authorization and the change manager may have predefined authority to take action or grant the authorization.

The relationship with processes component identifies ways and methods of tracking and tracing the source of changes in the VO business processes and services by identifying the cause of change, and the effect and impact zone of a change. If a change was triggered from out of the threshold performance indicators, the responsibility zone

method can help in the process of change by identifying the partner who is responsible for this trigger. Furthermore, the impact zone method can be used to identify the severity of change impact on the VO operations and goals. The following describes the two proposed methods in more details.

Method One: Identifying the partner responsible for out of the threshold performance indicators and the root cause of a change.

Identifying who is responsible for the unsatisfactory level of SLA is important to identify the corrective actions, the cause of a trigger and the responsible party for implementing the improvement (Kamali, 2013). This can be done by drilling down in the performance KPI structure developed in the SOVO performance management implementation. When the performance the VO is out of the agreed level of service, the root cause of the unsatisfactory SLA level can be identified by checking the lower level KPIs in the partner level. By drilling down in the SOVO KPI structure developed using the IBM Cognos BI , the responsibility zone can be identified. The responsibility zone is used to identify the partners that need to take the corrective action (Kamali, 2013).

The responsibility zone for each participating organization is the set of SLAs for their shared services in the collaborative processes. As illustrated in Figure 3-11, the responsibility zone for the missing performance level can be identified by drilling down in the SLA structure to reach to the responsibility zone. The change management console has an access to the SLA structure of the VO through the IBM Cognos BI where the change manager, CAB members or the VO partners can investigate the performance structure and check the VO and partner performance.

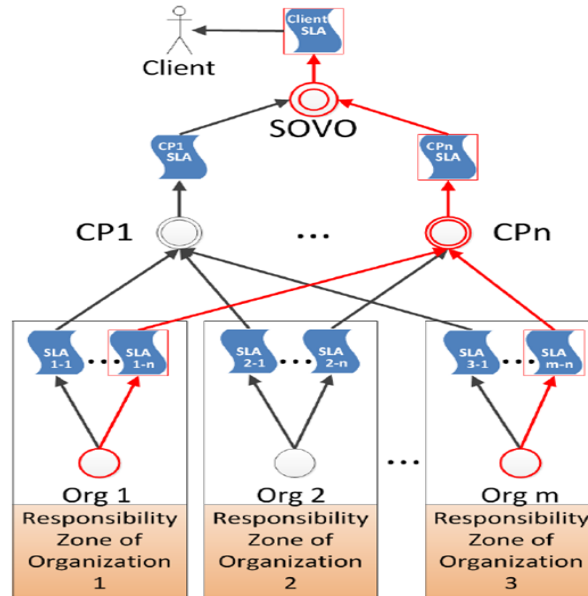


Figure 3-11: Drilling Down to Partners' Responsibility Zone
(Kamali, 2013)

Method Two: identifying the change impact zone which helps in identifying the severity of a change in the SOVO.

Any change in the SOVO can be propagated into different levels of change. For example, a change in the service level may propagate into high levels of change which affects the VO topology and configurations. Some changes in the business processes and services of the VO affect its operations with minimum impact whereas other changes require changes in different level with high impact. In other word, the severity of change in one level of change could vary from one change to another even though it is on the same level. The severity of a change in the SOVO assigned to each level of change indicating the seriousness of a change to the VO operations and collaboration at that level. It measures the degree of impact, the complexity of the change, and any undesirable consequences that the VO may face in initiating a change. Our proposed solution to measure the severity of change helps the change manager and the change initiator to assess the urgency of an RFC.

The severity of change can be identified by developing the VO value dependency graph, calculating the depth of influence and identify the impact zone of a change. The value dependency graph relies on the value object exchanges in the VO value network to

identify the dependency between each value object. According to Kamali (2013), the following describes the steps to generate the value dependency graph for a VO.

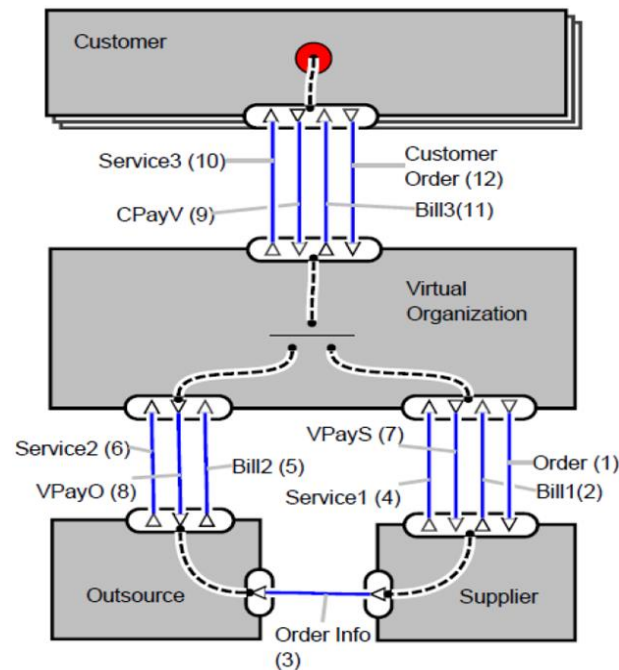


Figure 3-12: The VO Value Network
(Kamali, 2013)

Step one: Each value object in the VO value network will assign an ID as in Figure 3-12 where we have 12 value objects. The result is a set of values which start from v_1 and ends up with v_{12} . $V = \{v_1, v_2, v_3, \dots, v_{12}\}$

Step two: Developing the dependency matrix M which based on the direct dependency between v_i and v_j . If v_j cannot be performed without v_i , then v_j has a direct dependency on v_i .

* $V_{ij} = 1$ if v_i & v_j has a direct dependency

* $V_{ij} = 0$ if v_i & v_j has no direct dependency

$$\begin{array}{c}
 \begin{array}{cccccccccccccc}
 & v1 & v2 & v3 & v4 & v5 & v6 & v7 & v8 & v9 & v10 & v11 & v12 \\
 v1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
 v3 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v4 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
 v6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
 v7 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v8 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v9 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\
 v10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 v11 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
 v12 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
 \end{array} \\
 M = \left[\begin{array}{c}
 v1 \\
 v2 \\
 v3 \\
 v4 \\
 v5 \\
 v6 \\
 v7 \\
 v8 \\
 v9 \\
 v10 \\
 v11 \\
 v12
 \end{array} \right]
 \end{array}$$

Step three: for each value exchange in V, the immediate successive value (SV_i) should be counted using:

$$SV_i = \sum_{k=1}^n V_{ik} .$$

$$\text{For example: } SV_9 = \sum_{k=1}^{12} V_{9k} = V_{9,7} + V_{9,8} = 2$$

Step four: for each value exchange in V, calculate its depth of influence (DF_i) using the following formula:

$$DF_i = SV_i + \sum_{j=0}^n DF_j ; \text{ Where } V_{ij} = 1 \text{ in M matrix}$$

$$\text{For example: } DF_9 = SV_9 + DF_7 + DF_8 = 2 + 3 + 2 = 7$$

Step five: Rank and arrange the value exchange based on the DF from the highest DF to the lowest DF to generate the graph as illustrated in Figure 3-13. The figure shows the dependency of the value exchanges where numbers inside the circles represent the ID of the value exchange, and the blue numbers above each node is the depth of influence of that value exchange.

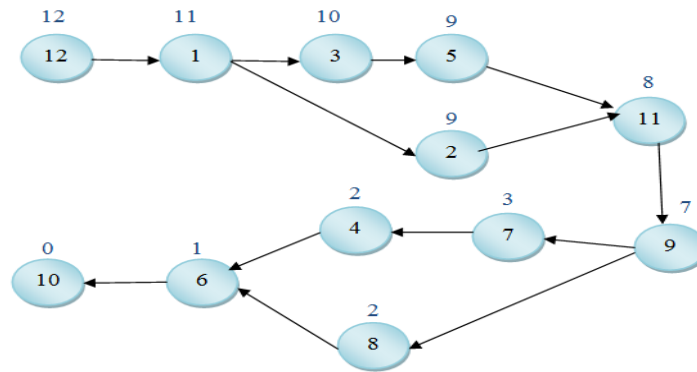


Figure 3-13 : Value Dependency Graph

In our proposed method, the depth of influence can be used to identify the severity of change to different value exchange objects. By analyzing the value dependency graph, we found that changes to the value exchange objects with less depth of influence have a low risk (severity) of change. On the other hand, the value exchange objects with high depth of influence have high risk (severity) of change in the VO operations. For example, initiating a change to the value object number 1 with DF 11 has more risk than initiating changes in the value object number 10 with 0 DF. The risk associated with the value object indicates the possibility of propagating the change into a different value object or different level of change. Identifying the severity helps the change manager and the change initiator to determine the urgency of a change request.

The change impact zone can be determined based on the dependency between the value objects. The change impact zone identifies which value objects can be affected by propagating the change to other dependence. Figure 3-14 illustrates the impact zone for changes in the value object number 9. The value objects 7 & 8 (Post) depend on the value object 9, and the value object 9 depending on value object 11 (Pre). Any changes in the value object 9 can be propagated into changes in the dependency value objects (11, 7 and 8).

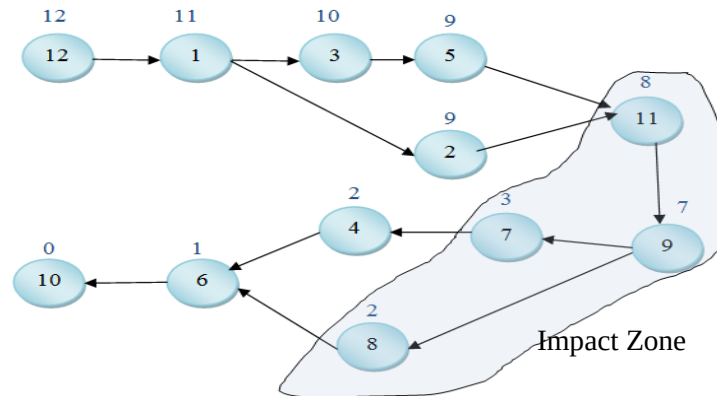


Figure 3-14 : Impact Zone of a value object

The escalations components consist of functional and hierarchic escalations used in case a change was taking long time, difficulty to execute or close a change faced in the process of change. The functional escalation refers to escalating the change problem to people with more skills like an expert. The hierarchical escalation refers to escalating the change problem to higher levels of management like involving the VO manager or the business people of one of the partners in the process of change. The VO coordinator will handle the escalation processes.

3.3.3 Change Collaboration and Decision Making

Collaboration is the process of sharing tacit knowledge, communicating and working together to accomplish stated goals and objectives (OGC, 2007b). There are different technologies that can be used to support the change management collaboration between the VO partners. Collaboration technologies allowing the VO to add a new competitive advantage by engaging distributed partners to work more closely together anytime, anywhere in a more natural and integrated ways. In our change management proposed solution, we used three different kinds of collaboration which include:

- Real-time form collaboration by invitation: the participants in the process of change are able to collaborate with any other participants in filling-out the change form's information through inviting them to collaborate. For example; the change manager can collaborate with the change initiator in assessing and validating the RFC through form collaboration.
- Online communication and collaboration using the IBM social toolbar: give a capability for change process participants to collaborate and communicate using

the IBM BPM process portal in a Web 2.0 collaborative work environment. Participates can start discussions, post their comments, @ someone, and post links in a social and interactive environment.

- Collaborative process between partners: by emerging the business processes between different VO participants to form collaborations. The VO partners collaborate with each other by providing solutions to the proposed change problems. This is done by calling *submitting solution service* which exists on the partners' side. Partners collaborate in the change process by submitting solutions for the proposed change.

The process of change decision making in a distributed and sensitive environment such as the VO should allow each partner to provide his/her opinion and comments regarding a proposed solution since no one solution can be forced. Partners can discuss the proposed solutions, and its details using the change management console. Then, eligible voting members can vote on the most feasible solution among the provided solutions. The voting percentages calculated in terms of the number of votes for each solution. Any voting tool can be used for the purpose of choosing the feasible solution. In our CM implementation, a voting tool has been used and integrated with the IBM process manager interface. The voting tool and the voting records will be maintained by the VO change manager.

3.3.4 Interfaces with the change management framework

There are different management processes which have primary interfaces and interaction with the change management process. Some of these management processes already investigated and implemented in the SOVO environment, which include the process management and the performance management. Others are still under investigation and ongoing research in the SOVO environment, which include the knowledge management in the SOVO. The rest of the management processes have interactions with the change management processes, but they have not been investigated yet in the SOVO environments. This includes problem management, configuration management and release management. The following briefly describes the management processes, which have an interface with the SOVO change management process, and highlight where the

change management needs to use an input or provide an input to one of the management process.

SOVO Business Process Management.

Provide a framework to form and manage VOs in a distributed environment based on the service oriented architecture. The framework and the implementation infrastructure enable networks of organizations to form virtual workflows based on their software infrastructures, share and monitor their performance metrics without the need for a central authority (M. Danesh & Raahemi, 2012). The SOVO PM facilitates distributed management of the VO, while keeping the actual organizations, their services and processes completely autonomous using service zones as an abstraction layer for the organization's services. The service zone allows organizations to share their collaborative services under specific rules and policies define by the VO business processes and service choreography (M. H. Danesh et al., 2011).

The SOVO change management consults the process management framework during the coordination and implementation layer where the process management framework provides steps to initiate and manage the VO, and provide solutions which can be used by the release management in implementing the new change release.

SOVO Performance Management

Provide an inter-organizational performance measurement system, which is specifically tailored to the requirements of service oriented virtual organizations. This framework includes a structure of performance indicators and a procedure for developing performance measures from strategy. The structural framework has three levels include the service performance level, collaborative process performance level and the value network level. Each level has its own key performance indicators (KPIs) to measure the performance of operation at that level. The VO performance management framework identified all the performance measurement criteria and their threshold which eventually trigger a change in one of the three levels (Kamali et al., 2012).

The SOVO change management and the performance management interact with each other's in different stages. Stage one, the performance management provides an input to the change management by triggering a change in one of the levels of change. This input is based on the measurements criteria identified in the PM structural framework and out

of the threshold performance indicators. Stage two, the performance management is used to evaluate the implemented changes in the evaluation and closure layer of change management process. Stage three, the change management provides the performance management framework with inputs which identified as a measurement criteria for the VO collaboration performance.

The inputs that the change management framework provides to the performance management are:

1. The commitment of a partner which represents the willingness of partners to avoid critical situations during the operation of the VO. This includes re-active and pro-active commitment. The re-active commitment describes the contribution and reaction of a partner by providing solutions during the collaboration and communication stage. The pro-active commitment describes the intention of a partner to actively collaborate to avoid critical situations before it is happened (Obidallah, Raahemi, Kamali, & Danesh, 2013).
2. The flexibility of the VO which describes the early ability to respond to internal or external changes , and the ability to adapt to the new situation without escalating the change. Internal changes include the changes made to the internal structures and procedures of VO in the different layers of change. The external changes include customer feedback and needs changes, business strategy changes and service providers' changes (Obidallah et al., 2013).

SOVO Knowledge Management

Knowledge management is about ensuring that the right information is provided to the right roles at the appropriate time (Bon et al., 2007). The SOVO knowledge management ensures that the knowledge developed during the operation and evolution phase of the VO is stored, and can be retrieved when needed. The KM is important to improve the fast response and decision making capabilities, and flexible problem solving capabilities to increase the performance of the VO.

The SOVO change management provides an input to the knowledge management during the communication and collaboration layer of change process where information and data developed at this stage is captured and stored in the Knowledge management Databases (KMDBs). Furthermore, Post implementation review (PIR) and lesson learned developed

in the evaluation and closure layer is stored in the KMDBs. Information and data stored in KMDBs can be used by change management during the identification and assessment layer. The KM usually has an interface with different management processes such as the problem management and the configuration management.

SOVO Problem Management

Problem management includes activities to diagnose root causes of events, determine the initial resolution of a problem, request changes (RFC) that resolve those root causes, and reduce the number of future events (Bon et al., 2007). The SOVO problem management ensures that the problem details and initial resolutions are submitted to the change management through an RFC. Problem management is the trigger of the change management processes and procedures.

SOVO Configuration Management

Configuration management provides process responsible for managing information about configuration items to deliver a service (Jong et al., 2008). It gathers information about different service components and how they relate to each other, which will help in providing details impact and risk analysis. The SOVO change management interact with configuration management in the initiation layer to store and recode the configuration item related to change request in the configuration management repositories. Furthermore, the change management consults the configuration management to assess the impact of a change based on the configuration items identified in the configuration management.

SOVO Release Management

Release management provides processes to ensure that there are clear and comprehensive deployment plans which bring alignment with customer and business change plans (OGC, 2007a). The SOVO change management interacts with release management through the VO coordinator in the coordination and implementation layer to ensure that the proposed changes are installed, tested, and deployed efficiently and on the agreed schedule.

Chapter 4 : Prototype and Scenarios of CM in SOVO

In order to validate and test our proposed framework, we consider two different change scenarios in a hypothetical SOVO. In the created SOVO, two organizations include a wireless service provider (WS), and a cell phone service provider (CP), bundled their services to provide an added-value service package to their customers. The final product is a cell phone with activated wireless services on it delivered to the customer. The VO provides its service under a new brand name which is “VOWireless”.

The VOWireless consist of two partners who collaborate with each other to achieve the purpose of the VO. A customer can submit a request for quotation that includes the specifications of the cell phones and the wireless service. Each of the two partners receives the related information, process the request, and provide an aggregated quotation to the customer. Then, the customer submits an order request based on the received quotation. The cell phone service provider (CP) prepares cell phones with SIM card, and initiates the shipment of the requested cell phones to the customer. The wireless service provider (WS) makes sure that the service is activated upon delivery to the customer. The value network of the collaboration between the cell phone provider (CP) and wireless provider (WS) to form VOWireless is illustrated in Figure 4-1 using the e³-value ontology.

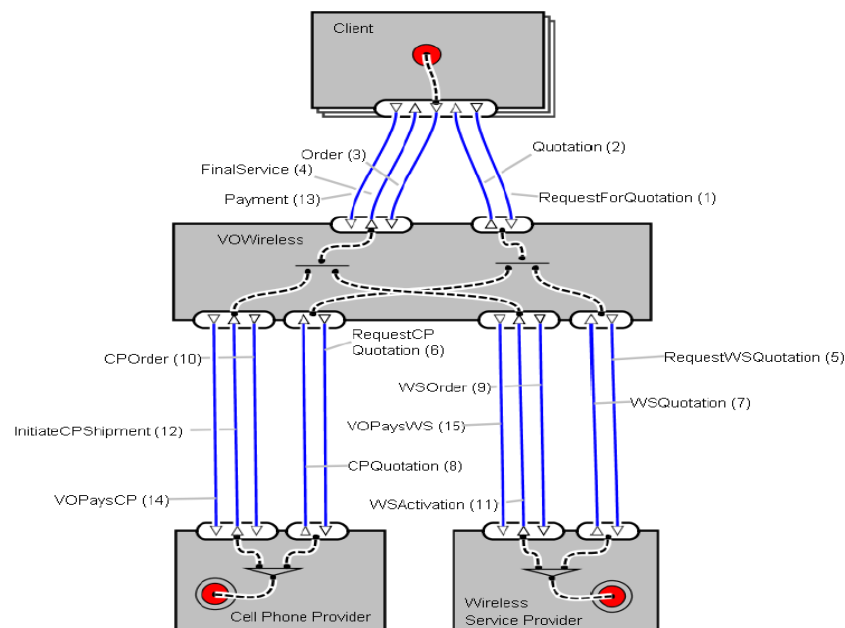


Figure 4-1: The Value Network Model for VOWireless

The value objects which are exchanged between the roles of the value network can be any type of product, service, information and money. The value exchange's description explained in Table 4-1.

Table 4-1: Descriptions of the VOWireless value objects

ID	Value Object name	Description
1	Request for Quotation	The specification of the wireless service and the cell phone which is submitted by the customer to VOWireless.
2	Quotation	Quotation for the wireless service and the cell phone provided by VOWireless to the customer.
3	Order	Order for the service package submitted by the customer to VOWireless based on the received quotation.
4	Final Service	Service package including wireless service activation and cell phone with SIM card and shipment initiation.
5	Request Quotation for WS	Request for quotation for wireless service issued by VOWireless to the wireless service provider in order to respond to the customer request.
6	Request Quotation for CP	Request for quotation for cell phone issued by VOWireless to cell phone provider in order to respond to customer request.
7	Quotation for WS	Quotation for wireless service provided by the WS provider to VOWireless.
8	Quotation for CP	Quotation for cell phone provided by the CP provider to VOWireless.
9	WS Order	Order for WS submitted by VOWireless to the WS provider.
10	CP Order	Order for CP submitted by VOWireless to the CP provider.
11	Wireless Service Activation	Activation confirmation of wireless service which is performed by WS provider.
12	Initiate Cell Phone Shipment	Initiation of cell phone shipment which is performed by CP provider.
13	Customer Payment	The money that the customer pays to VOWireless for the service package.
14	VO Payment to WS Provider	The money that VOWireless pays the WS provider for WS activation.
15	VO Payment to CP Provider	The money that VOWireless pays CP provider for CP properness and shipment initiation.



Quotation Submit



Order Submit

Since the collaborative processes in the SOVO are modeled by service choreography, the VOWireless service choreography has been derived from the value network using a method identified in (Kamali et al., 2012). The service choreography focuses on partner collaboration and service interactions by specifying each role and activities, and the sequences of service invocations. Figure 4-2 illustrates VOWireless service choreography model.

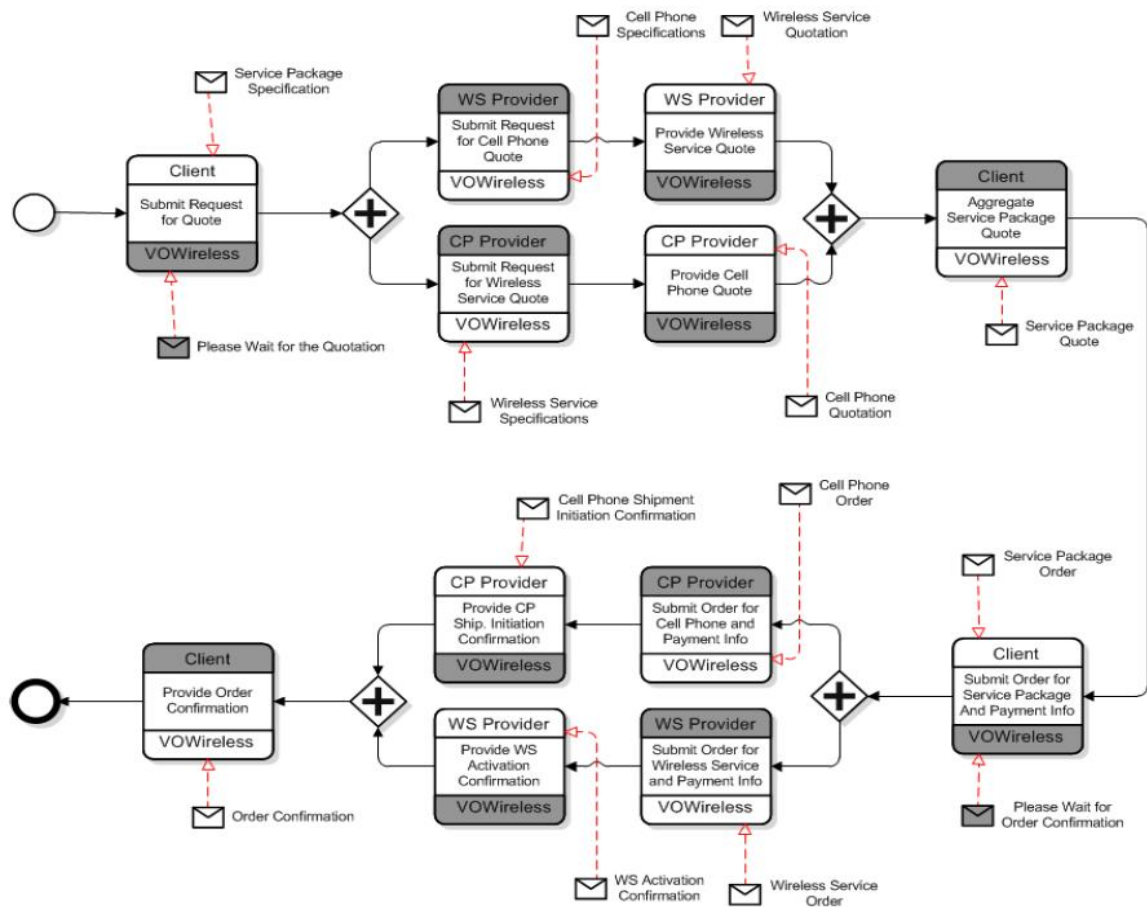


Figure 4-2: The VOWireless service choreography model

The VOWireless is implemented in a lab environment by allowing the CP and the WS to collaborate with each other to provide the final service package to the customer. In order to measure the performance of the VO, a SOVO performance framework has been developed and implemented to identify key performance indicators (KPIs) in the three layers of the SOVO. The performance implementation has been used in some cases to measure the performance of the VO after implementing changes. The following provide two scenarios of changes in the prototyped SOVO environment.

4.1 Scenario One: The performance indicators as a trigger of change

Based on the performance indicators identified in the SOVO performance management framework, and the information retrieved from the IBM Cognos BI, Figure 4-3 illustrates the VOWireless service availability performance. The VOWireless service availability performance should not be less than 85%, which is the threshold agreed on for the VO service availability performance.

According to the performance extracted from the IBM Cognos BI, the VO service availability performance is 84.8% which is out of the agreed level of performance. This is a trigger of change that comes from the performance indicators of the VO. The VOWireless Change Advisory Board (CAB) members will be alerted about the out of the threshold service performance, and an action needed to respond to this alert. The CAB members need to initiate the process of change by submitting a request for change (RFC).

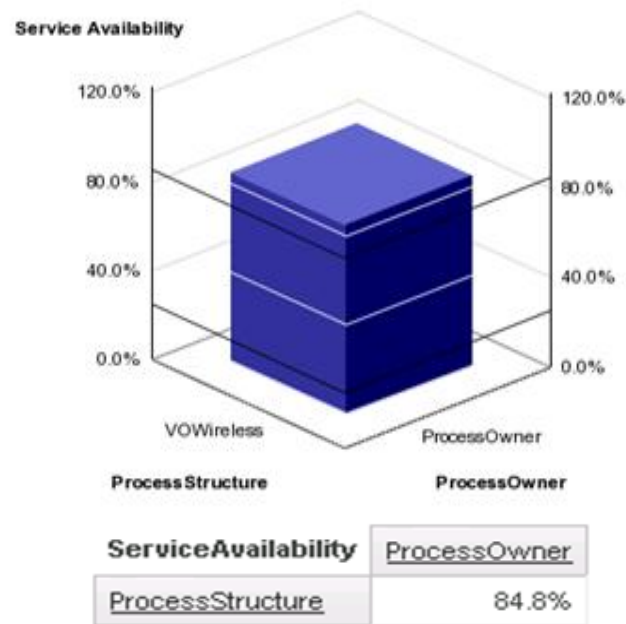


Figure 4-3: The VOWireless availability performance

4.1.1 Change Initiation

The VOWireless CAB members (change initiator) and change manager need to work together by submitting a request for Change (RFC) where they:

- Identify the root cause of the problem.
- Provide an initial solution.
- Provide an initial impact of change.

- Provide an initial level of changes.
- Change description.
- Identify how not implementing this change effect the VO.

In this case, a request for change (RFC) should be submitted where the CAB members of both the cellphone provider and wireless provider can collaborate and communicate using the change management console (process portal) to identify the RFC required information. The CAB members can invite any party to collaborate and participate in identifying and filling in the required information as illustrated in the Figure 4-4.

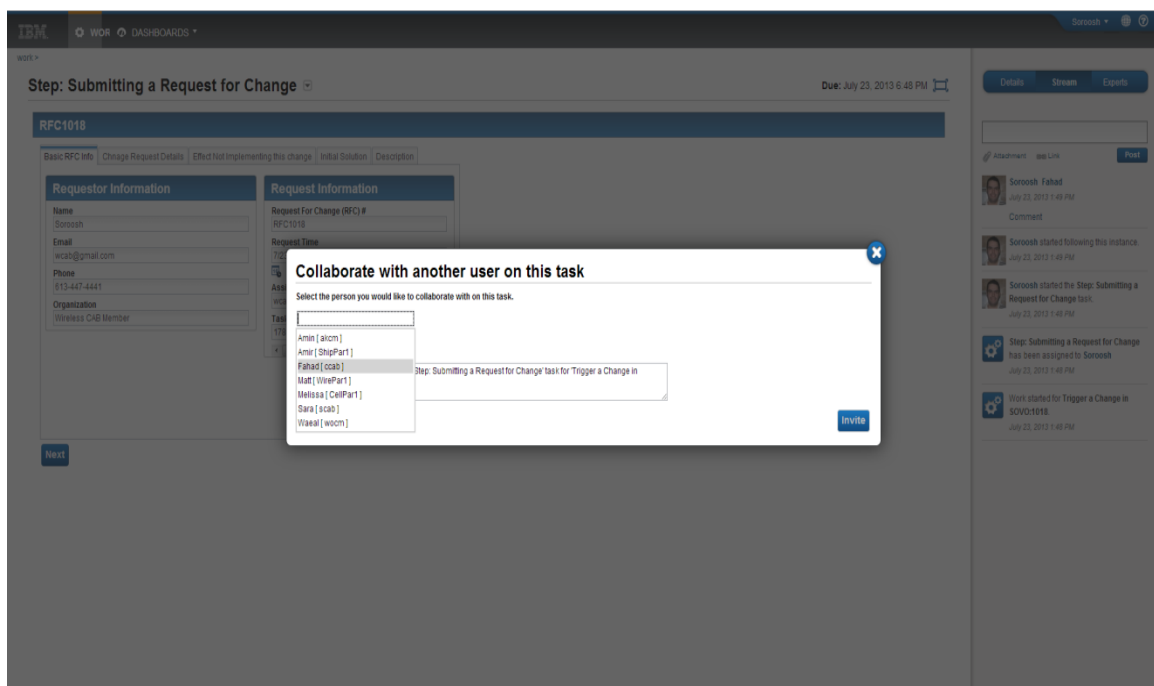


Figure 4-4: Collaboration by invitation

- Identifying the root cause of the problem: since this is a performance indicators trigger of change, we can use the traceability function of SLA structure identified in the performance measurement framework using the IBM Cognos BI. By using the SOVO Change Management Console (Business Space), we can drill down to identify the responsibility zone, which shows the responsible party for the missing SLA of Service Availability as illustrated in Figure 4-5.

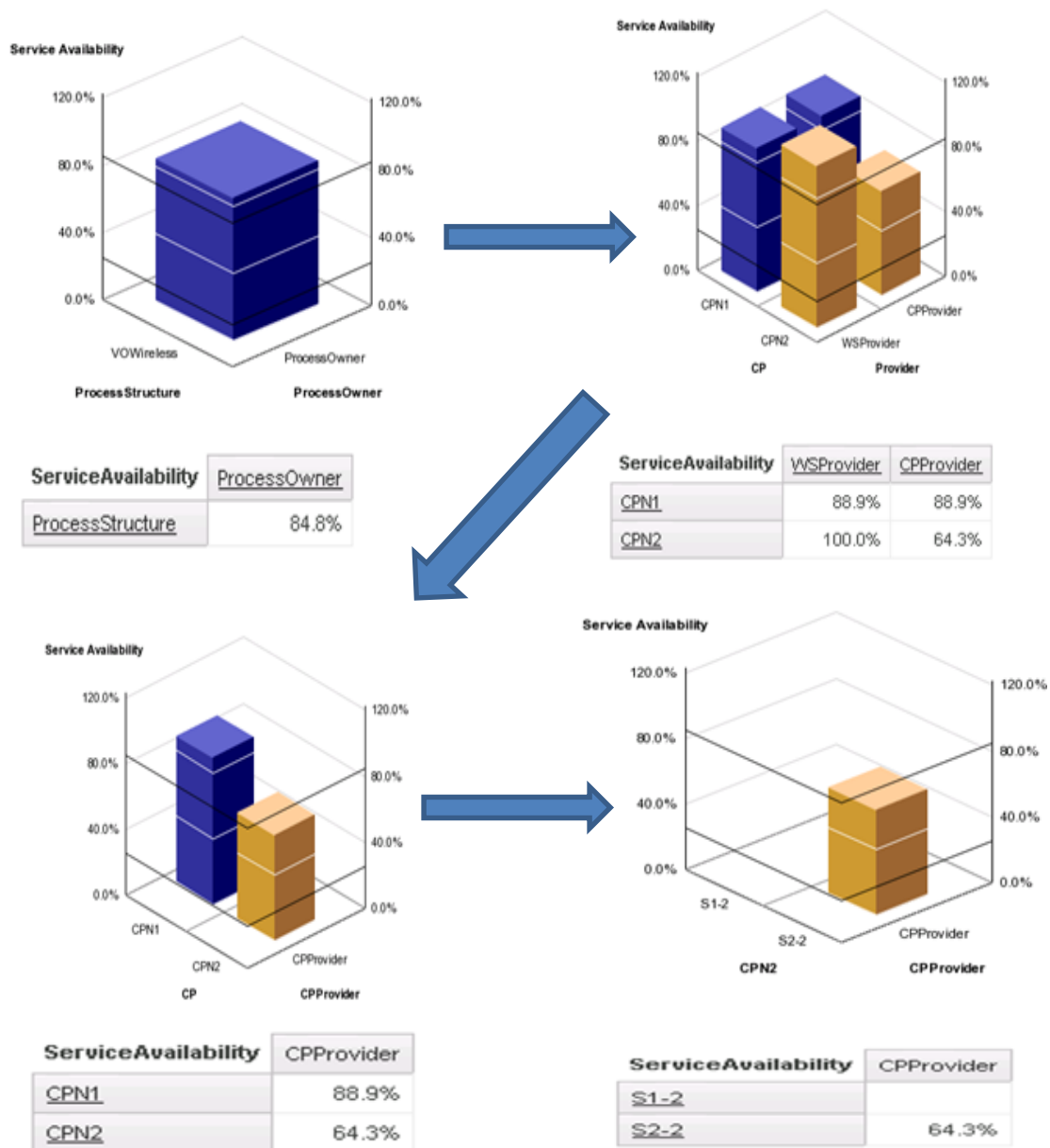


Figure 4-5: Identifying the responsible party

According to the drilling down process, the cell phone provider is the party responsible for launching the VOWireless out of the threshold alert. After investigating collaborative process node 2 (CPN2) as illustrated in Figures 4-6, we came up with the conclusion that the cell phone provider's collaborative process for initiating cell phones shipment with value object (ID#12) is the bottleneck here.

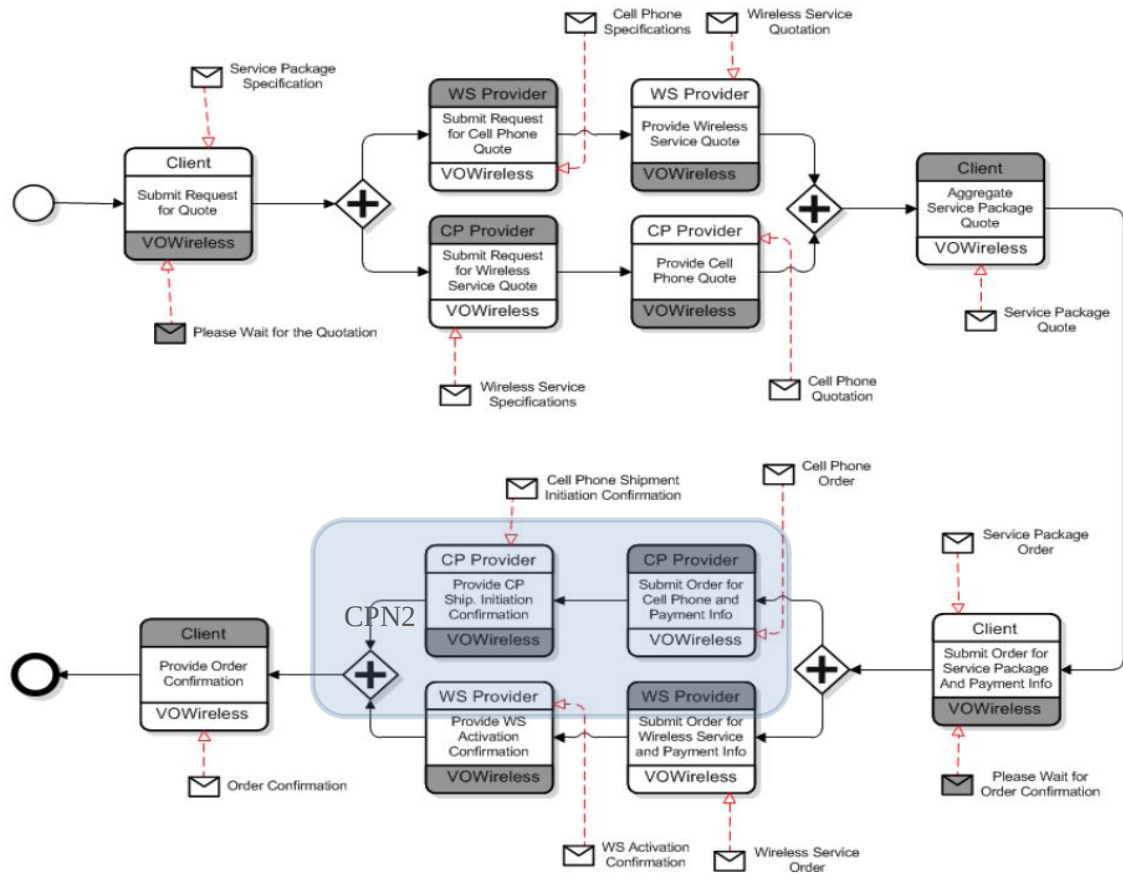


Figure 4-6: Responsible partner collaborative processes

- **Initial solution:** adding a new partner to the VO who is responsible for the shipment service. This new service provider will handle the shipment process instead of the cell phone provider. This will increase the capacity of value creation by allowing the VO to ship more of the final product to customers. Table 4-2 illustrates the current VO value creation before adding the shipment provider. It shows that the CP is the bottleneck to increase the value creation of the VO.

Table 4-2: Current VO value creation

Code	Indicator	WS Provider	CP Provider	VOWireless
V1.2	value creation capacity per week	1250 services	850 shipments	850 service package
V2.1	structured value delivery channels	100%	75%	93.75%

- **Initial level of change:** Since a new partner will be added to the VO, this is a high level change in the value network level (change in the business). It affects the value creation and the configuration of the VO. It involves adding a shipment service provider to the

consortium of legally independent organizations. This change will propagate into change in the collaborative process level and the service level.

- Initial impact of change: This is high level change with change in the value network, so, it has a high impact. We can determine the severity of change by identifying the change impact zone for value object initiate Cell Phone shipment (ID#12) using the value dependency graph. Figure 4-7 is the value dependency graph with the impact zone for value object number 12.

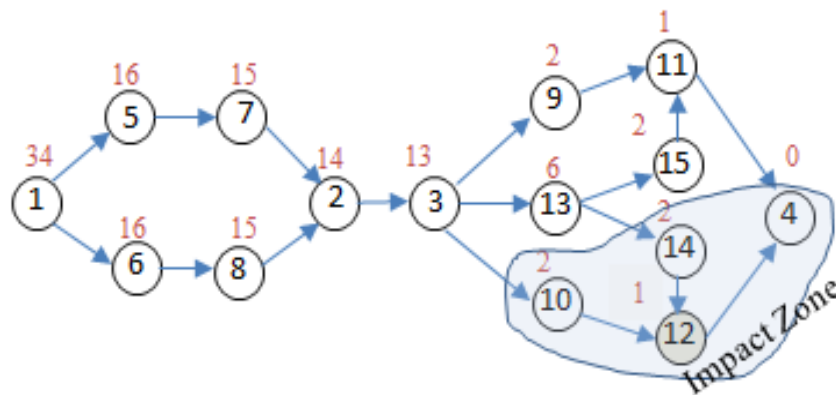


Figure 4-7: Impact zone for initiate Cell Phone shipment

The impact zone includes the value objects with ID 10, 14 and 4. Changing initiate Cell Phone shipment will influence only one value object and may propagate into two other objects. The depth of influence for this value objects equal 1 out of 34. Based on the previous information, this is a high level change with high impact and low severity on the VO.

- Change description: This is a change in the value network level where a new partner who provides a shipment service will be added into the VOWireless. New value network, new service choreography and new service to improve the VO performance. This is a top-down change that requires negotiation and decision making.
- Identify how not implementing this change effect the VO: the VOWireless will not be able to satisfy customers and market demands and the service level agreement. This is out of the threshold change trigger which needs to be fixed.

After filling in all the RFC required information, the change manager will receive a new task for reviewing and filtering. Based on the received information, the change manager will review, accept or reject the RFC. In this case, the change manager will accept the RFC request. A notification will be sent to the change initiator (CAB). Furthermore, an

automated update will be posted on the process stream of the social toolbar regarding the RFC status.

4.1.2 Change Identification and Assessment

The VOWireless change manager will work and communicate with the change initiator (CAB) to:

- Valid classification.
- Validate the impact on the business.
- Identify the urgency of the change to the business.
- The new goals and objectives that the new partner need to satisfy.
- Based on the impact and the urgency, the change manager prioritizes the change.
- Notify partners for communication and collaboration if needed.

The change manager can invite any of the CAB members for form collaboration to provide the required information and validate it together or start a discussion on the process portal's social toolbar as illustrated in Figure 3-8.



Figure 4-8: Social toolbar collaboration

- Change classification: this is a change in the value network level.
- Impact on the business: high impact on the business which requires collaboration and decision making between VO participated organizations. .

- Urgency: based on the severity of the change identified by the impact zone, this change has low urgency. This change is to improve the business and meet customers and market requirements.
- Priority: moderate based on Figure 3-10. (High impact + low urgency = moderate)
- Goals and objectives: the new shipment service provider should be able to perform at least 1000 shipments per week to overcome the shortage in the shipment. This is the new service level agreement that the shipment service provider should agree on. This will increase the overall VO value creation to their customers.
- Partner collaboration notification: affected partners including the WS provider and the CP provider need to be notified to discuss the problem and provide solutions. A discussion started with affected partners before going to the next stage where the alternative solutions should be submitted by partners.
- Assigning change authority: since this is a high level change that will affect the value network, choreography and level of service, the CAB members will be responsible to authorize this kind of changes.

4.1.3 Change Collaboration and Decision Making

This is a sub-process which calls request for solution service to be submitted by partner.

It provides the process of change with:

- Alternative solutions to the problem.
- Alternative analysis for each solution.
- Risk and impact analysis for solutions.
- Ways to test and evaluate the proposed solutions.
- Voting on the proposed solutions.
- Selecting the potential solution.

After starting a discussion regarding possible solutions for out of the threshold service availability problem, the WS and the CP provide their possible solutions for the problem. The submitted initial solution will be considered for voting, and will be submitted by the change manager. Table 4-3 shows possible solutions which could be provided by the WS and the CP. The process of submitting solution done by calling a service (submitting solution service) where partners submit their proposed solutions for voting.

Table 4-3: Details of the submitted solutions

	CP provider	WS provider
Alternative solutions	It is the client responsibility to pick up the package from our locations.	Outsourcing the shipment process. the CP deals with UPS or FedEx.
Alternative analysis	Final package will be ready to pick up by the client at store locations. The VOWireless not responsible for delivering the package. The client needs to make arrangement with shipping companies if he/she needs shipment service.	The CP partnership with a shipping company to handle delivering the final service package to clients. The VO can charge the customer for the shipping cost.
Risk and impact analysis	Customer satisfaction about the services provided by the VOWireless will decrease. Most of our customers have an arrangement with shipping providers. So, this will not impact our business with most of our existing customers.	No risk to the VOWireless, since the shipping company work as a contractor with the CP not as a part of the VO. Although, the price of the shipping service could be higher if we are looking for high quality shipping services.
Test and evaluate	Customers choose their own shipping providers, get customer feedbacks and recommendations, and launch testing with customers.	Identify potential shipment providers, identify average shipment time and price, go for a test for a couple of months and get feedback.

Figure 4-9 shows all the detail solution submitted by the change manager, the CP and the WS which is ready to go through the voting process.

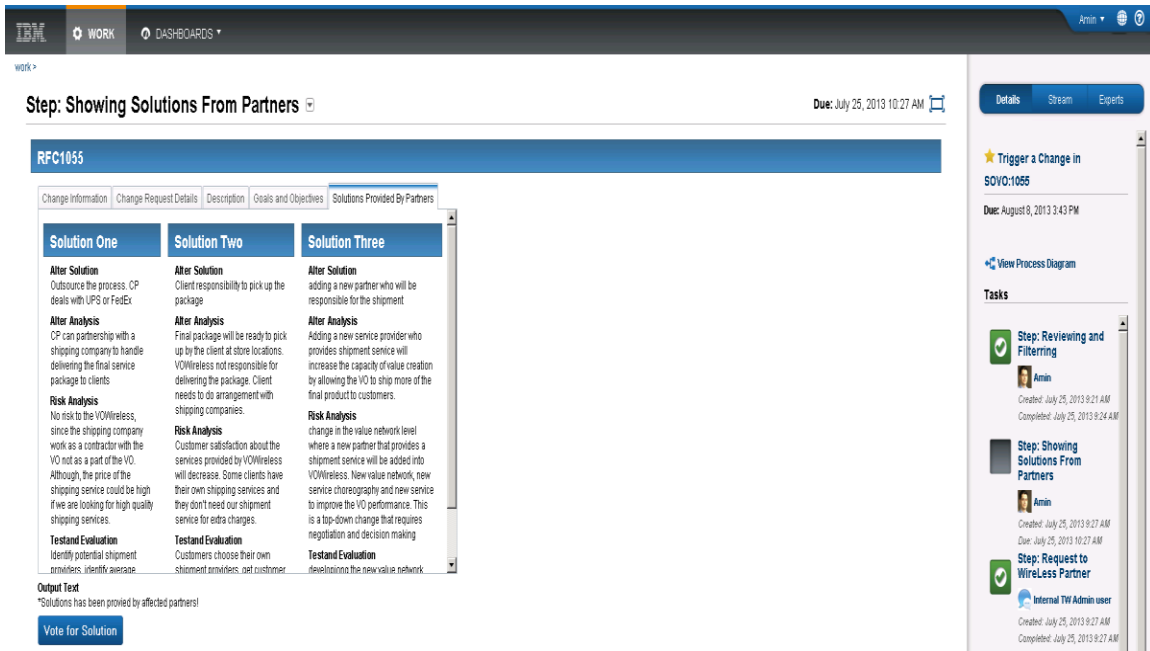


Figure 4-9: Submitted solutions ready for voting

- Voting on the proposed solutions:

Only the eligible voting members are able to vote on the most feasible solution. The Cell Phone CAB member (CCAB), the Wireless CAB member (WCAB), the change manager, the VO coordinator and an invited expert can vote using a voting tool to decide which solution is the most feasible to the VOWireless. Figure 4-10 shows the interface used to vote for a solution.

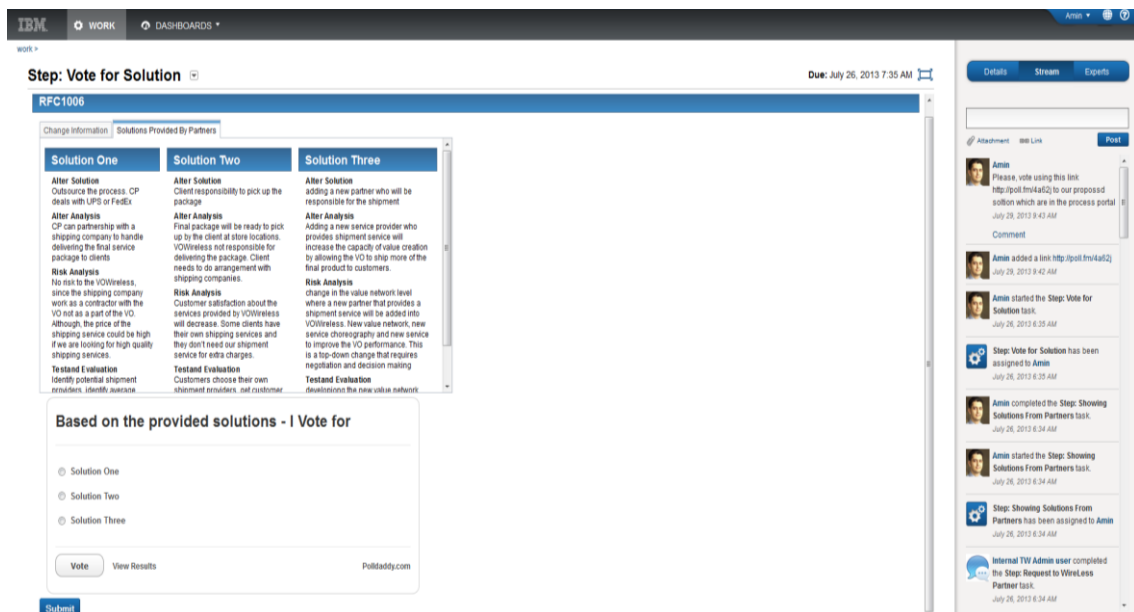


Figure 4-10: The voting tool in the IBM BPM

- Selecting the potential solution:

The change manager identifies the solution based on the voting process result. From the voting result, adding a new partner who will handle the shipment process is the most feasible solution with the highest voting percentage among the other solutions. Figure 4-11 shows the voting result from the voting tool interface which handled by the change manager.

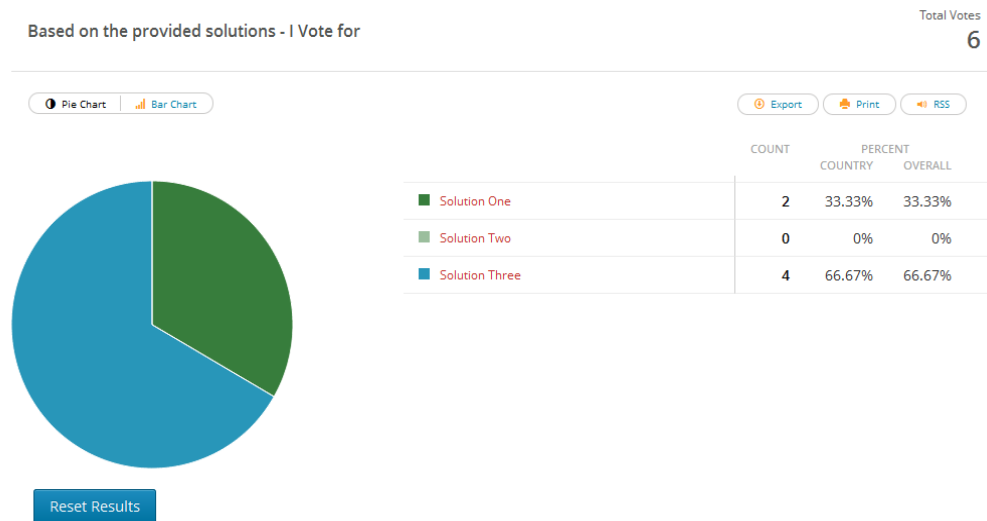


Figure 4-11: The voting result

4.1.4 Change Planning and Authorization

In this layer, the change manager collaborates with the change initiator (CAB) to develop the implementation and remediation plan. The authorization of change can be determined based on the level of change.

- Implementation plan: a document that includes the new VOWireless value network and service choreography after adding the shipping service provider (SP) , the change window, remediation plan and other change specifications.

In the value network layer, the VO will change its own value creation model by adding the new service provider. Figure 4-12 shows the new value network model for VOWireless:

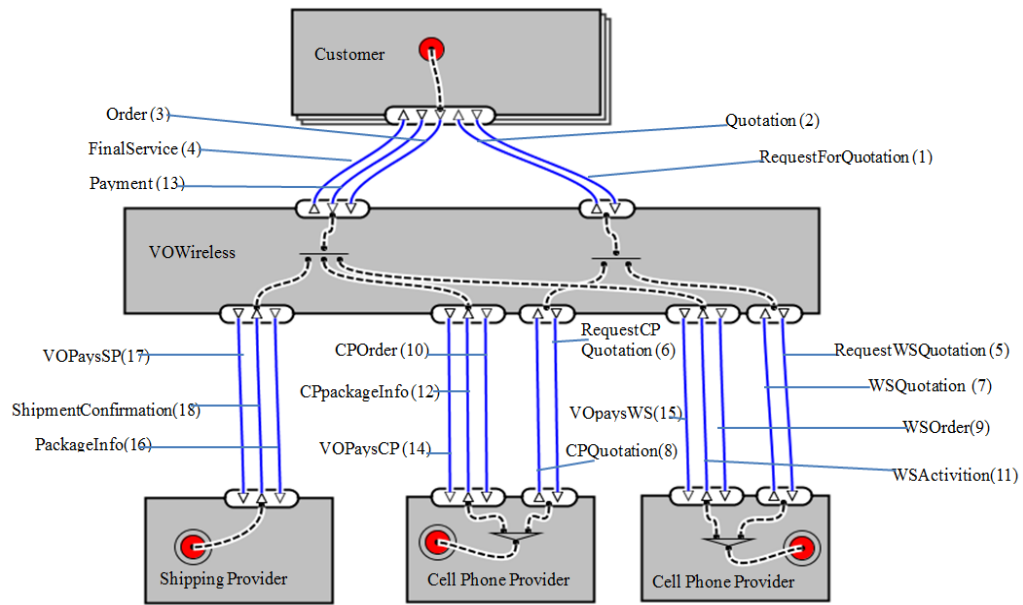


Figure 4-12: The new VOWireless value network model

In the collaborative process layer, the VO will add the shipping service provider business process (service) in the VO collaborative processes. Figure 4-14 shows the new service choreography after adding the shipping provider:

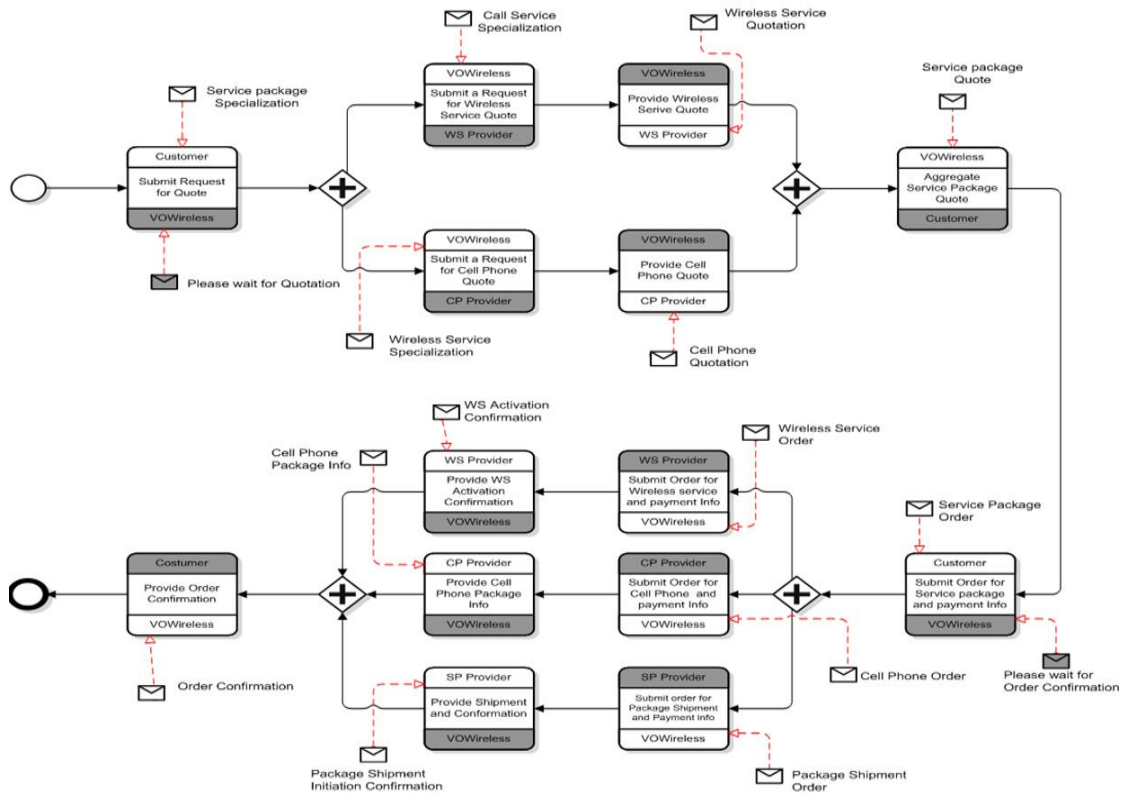


Figure 4-13: The VOWireless new service choreography

In the service providers level a new service provider is selected to provide the shipment service for the VOWireless.

- The change window indicates the time for implementing the change: July 26th, 2013 at 2:00 AM EST.
- The Remediation plan: backup and restore to the previous version of VOWireless.
- Obtain Authorization: Since this is a high level change in the value network level, it requires CAB members' authorization. The WS and CP CAB members need to discuss this change by starting a discussion using the social toolbar in the change management console to come up with the final result. The CAB members will authorize this change.

4.1.5 Change Coordination and Implementation

- Assign implementer: the VO coordinator will be responsible to coordinate between the new shipping service provider (implementer) and the release manager to make sure that the new VOWireless is configured in the way to include all the three service providers. The implementation part is one of the duties of the release management.
- Distribute update: Updating all affected partners (WS, CP and SP) about the status of the configuration process. At this stage, the new VOWireless is configured and working properly.

4.1.6 Change Evaluation and Closure

After implementing the changes, the VO needs to evaluate and monitor the implemented change using the performance management framework to ensure that risk have been managed and the new modification meet the requirements identified in the implementation plan.

- Monitoring change: the change manager and the CAB members monitor the VO performance after any changes. Since this is out of the threshold KPIs trigger of change, the implemented change to the VO should be able to solve the problem by maintaining the required VOWireless performance. Figure 4-14 illustrates the performance of the VO after adding the shipment service provider.

- Post implementation review and lesson learned: based on the performance of the VO, the proposed change was successful. The implemented change met the CAB members' expectations. Possible opportunities for improvement include increase cell phone provider service availability and reduce the total time to accomplish a service. This task done by the change manager.

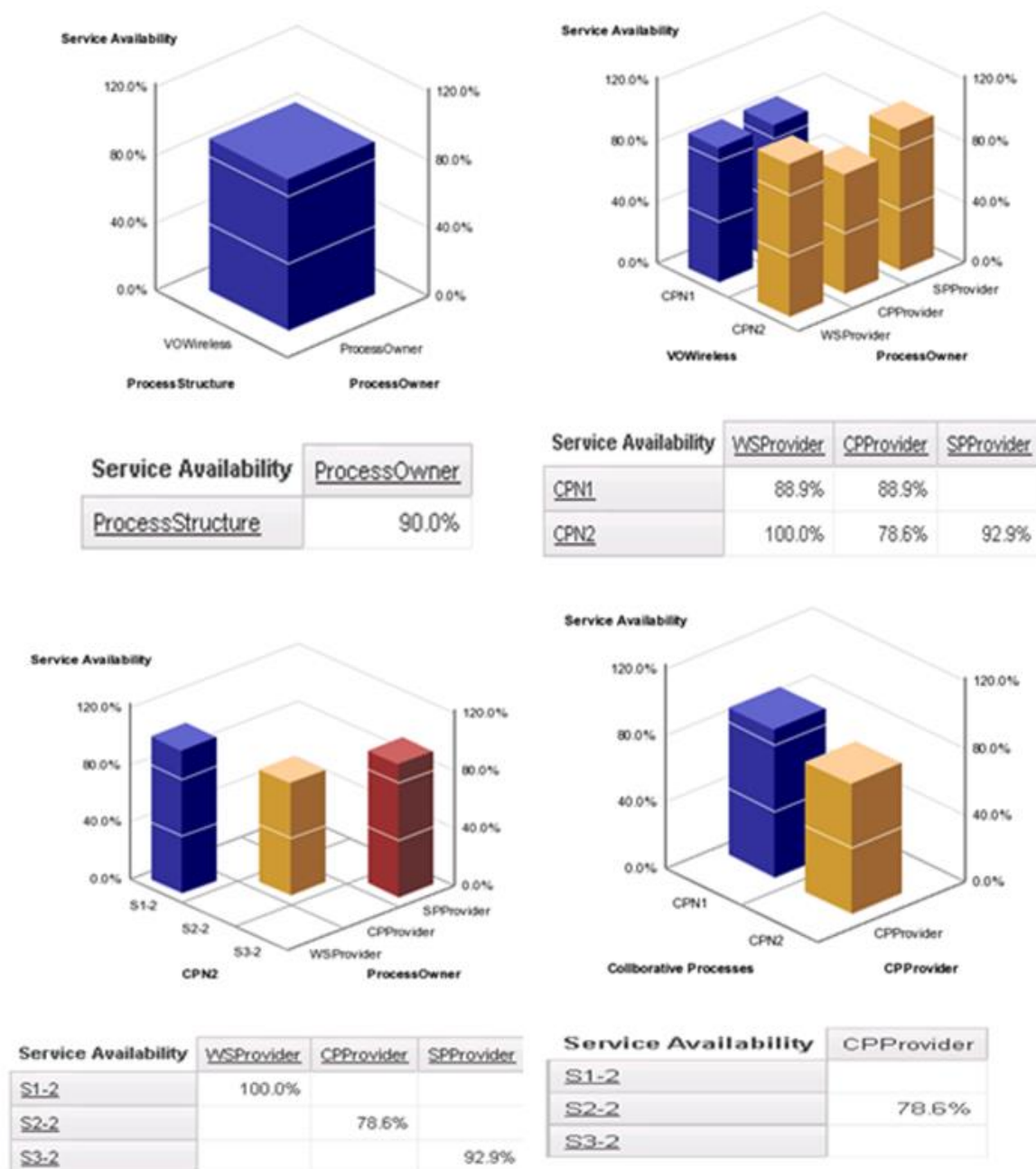


Figure 4-14: The VOWireless performance after implementing the change

4.2 Scenario Two: Customer feedback and needs as triggers of change

Customer feedback and needs is one of the triggers of change in the SOVO. The VOWireless is looking to maximize its profit by meeting customers and markets demands and needs. In order to meet customers' demands and needs, changes maybe trigger in the VO different levels of change. In the VOWireless, customers identified their needs to have the exact service package delivery date and the tracking number for the package. The VOWireless CAB members' received the customers' request and they need to respond, and react to meet customers' needs. To do so, a request for change (RFC) has been submitted by one the VOWireless CAB members.

4.2.1 Change Initiation

The CAB members respond to customer needs by submitting a request for change (RFC) where they:

- Identify root cause of the problem: Customers were not able to identify the exact service package delivery date after confirmation. So, they require the VOWireless to provide them with the exact date for delivering the package and the tracking number.
- Provide initial solution: The shipping service provider delivers the required information to the VOWireless. The VOWireless make sure that the customer receives the confirmation with the required information needed. The required information includes the delivery confirmation with package tracking numbers.
- Provide initial level of changes: this change is a high level change in the collaborative process level of the VOWireless. It is tactical change in the business processes, which will affect the service choreography of the VOWireless. This change will propagate into low level changes in the service providers' level where the shipping service provider needs to modify his/her service.
- Provide initial impact of change: This change is in the collaborative process level with medium impact on the VO operation and collaboration. We can identify the severity of the change by determining the change impact zone. Figure 4-15 shows the impact zone using the service choreography. The service choreography derived from the value dependency graph for VOWireless after adding the shipping provider. Based

on the impact zone, the value object has 1 depth of influence which is low severity to the VO.

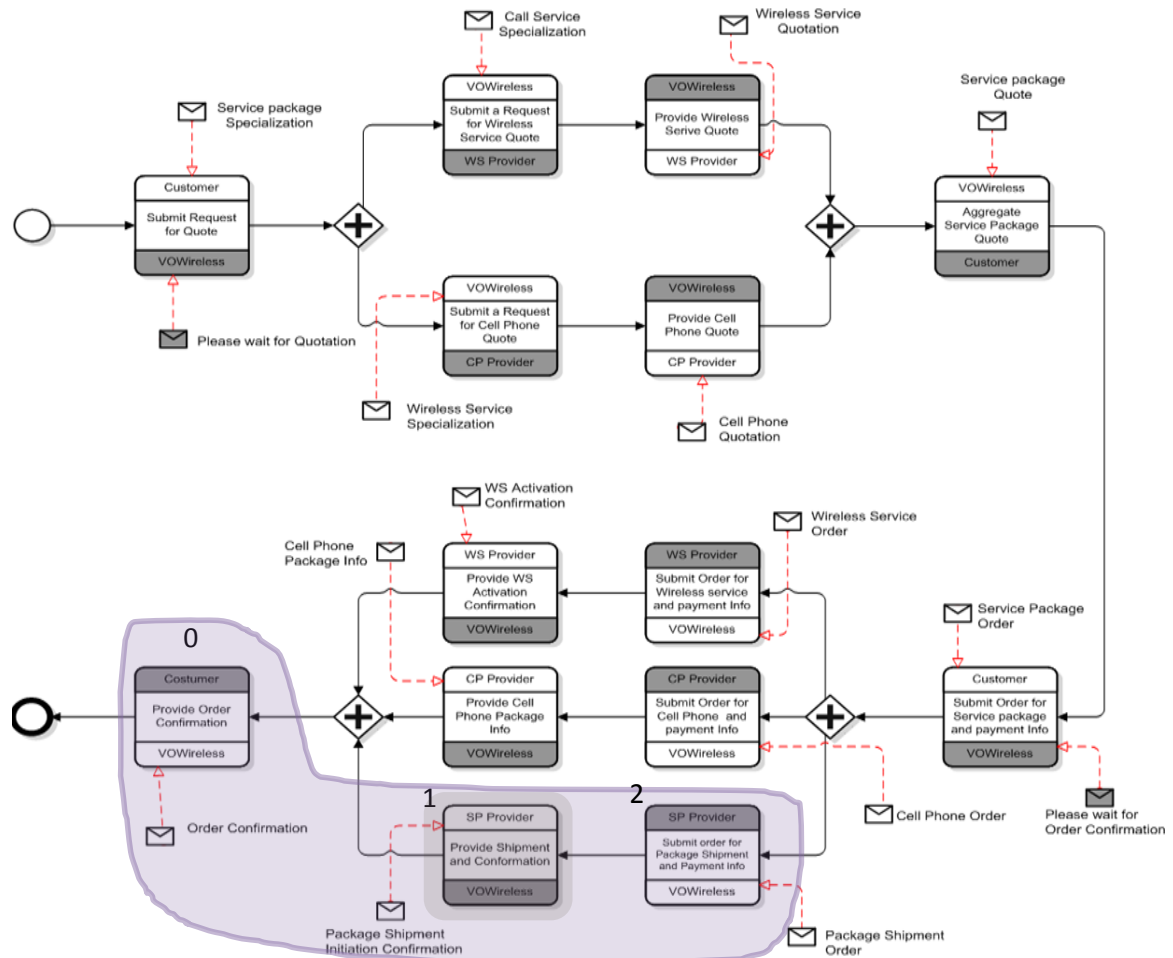


Figure 4-15: The impact zone using service choreography

- Change description: High level change in the collaborative process level of the VOWireless, which will propagate into low level change. It requires a small change in the VOWireless choreography, and adding new parameters to pass the tracking number to the customer in the service level. This change has been triggered to meet customer's needs.
- Identify how not implementing this change effect the VO: It will affect the VOWireless relationship with their customer. Implementing this change will increase our customer satisfaction.

Reviewing and filtering: Based on the received information, the change manager will review, accept or reject the RFC. In this case, the change manager will accept the RFC

request otherwise a proposal is needed. A notification will be sent to the change initiator. Furthermore, an automated update post will be shared on the process stream regarding the status of the RFC.

4.2.2 Change Identification and Assessment

The VOWireless change manager invites the change initiator (CAB members) to collaborate in providing information which is necessary to validate this change. The collaboration and communication can be done through the change management console using the social toolbar or the form collaboration:

- Change classification: change in the collaborative process level.
- Impact on the business: medium impact with high level change which propagate into low level changes.
- Urgency: low. This change is to improve the business and meet customers need.
- Priority: low (high level change with medium impact- low urgency).
- Goals and objectives: The shipping service providers submit the tracking number to the VOWireless and identify the expected day of delivery.
- Assigning change authority: since this is a high level change that affects the collaborative process and the service level, the change manager is responsible to authorize this change with the CAB members' confirmation.
- Partner collaboration notification: there is only one affected partner in this change which is the shipping partner. So, there is no need to notify the other VO partners for collaboration and decision making.

4.2.3 Change Planning and Authorization

- Implementation plan: a document that showing the VOWireless new service choreography, the change window, remediation plan and other change specifications. This is done by the change manager and the change initiator.

In the collaborative process level, new service choreography is developed as illustrated in Figure 4-16:

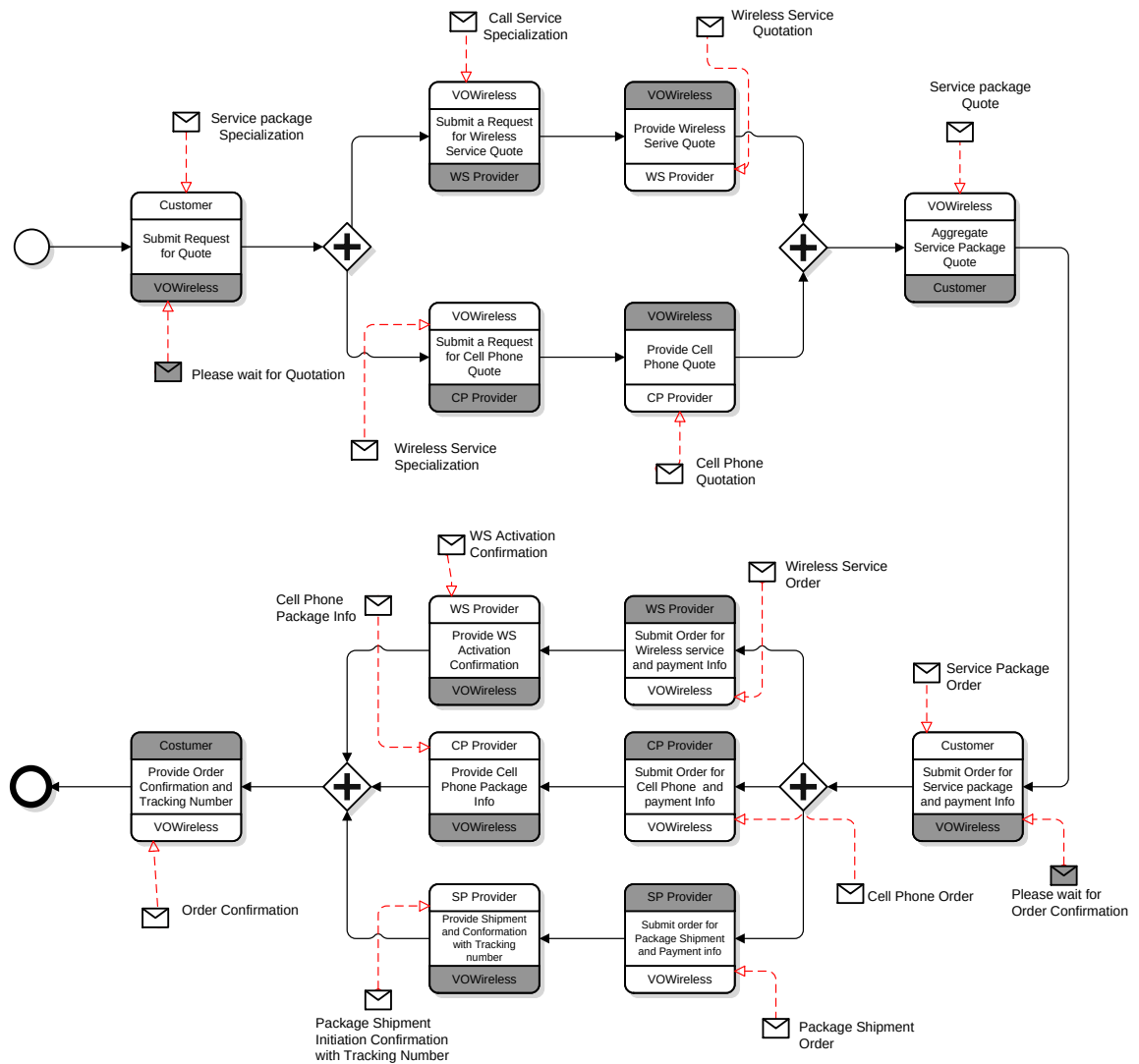


Figure 4-16: The new service choreography

In the service provider level, the shipment service provider updates his/her service by adding a new parameter (TrackNumber) to pass the required information to VOWireless. The service will be published as a web service where the VOWireless use it in the collaborative process level.

- The change window indicates the time for implementing the change: August 26th, 2013 at 2:00 AM EST.
- The Remediation plan: backup and restore to the previous version of VOWireless.

- Obtain Authorization: the change manager will be responsible to authorize this change after the CAB members confirmation. The VOWireless CAB members need to communicate with each other to confirm this change.

4.2.4 Change Coordination and Implementation

- Assign implementer: the VO coordinator will be responsible to coordinate between the shipping service provider and the release manager to make sure that the service choreography is configured and the VOWireless provides customers with the tracking number of their service package.
- Distribute update: After configuring the new service choreography, all the VOWireless partners should be updated about the status and details of the change.

4.2.5 Change Evaluation and Closure

After implementing the changes, the VO needs to evaluate and monitor the implemented change and conduct the PIR.

- Monitoring change: Since this change is based on the customer needs, the only way to measure the success of the change is to get customer feedback after implementing the change. The CAB members are responsible to get customer feedback regarding their satisfaction with the implemented change. A survey could be sent to customers or direct communications tool could be used to get their response back. If customers are happy with the service, the RFC is closed.
- Post implementation review and lesson learned: based on the feedback from customers, we assume that the change was successful. The implemented change met the customers need and expectations. This task done by the change manager.

4.3 The Prototype and Implementation in Action

We employ the IBM BPM process designer to implement change management processes including initiation, identification and assessment, planning and authorization, coordination and implementation, and evaluation and closure as in Figure 4-17.

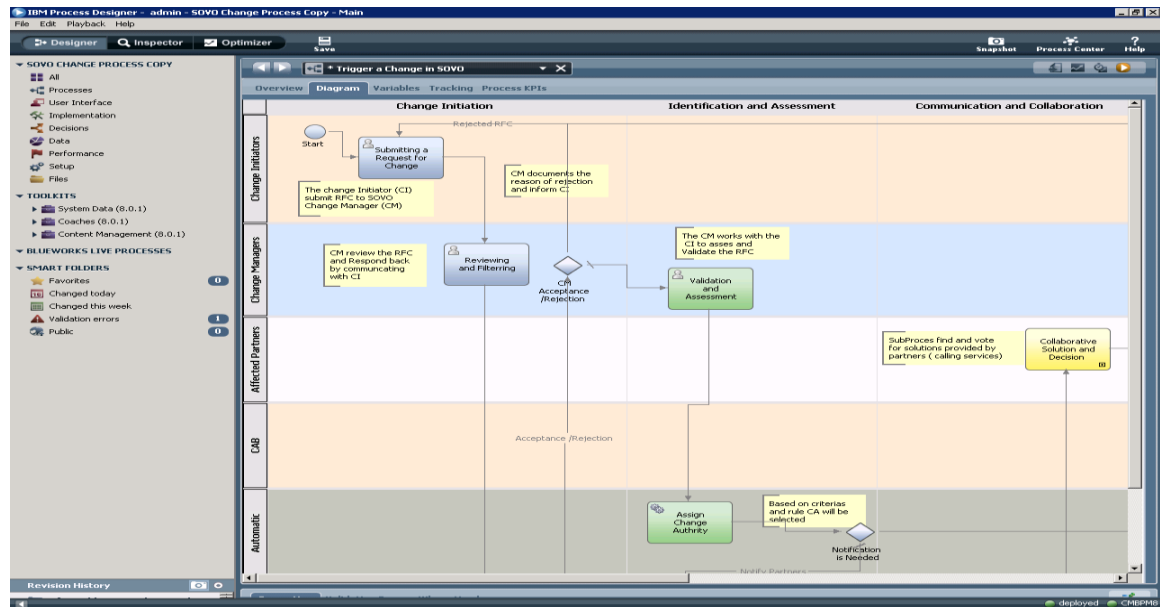


Figure 4-17: Change management processes

We implement the change management process in the collaboration and communication layer as collaborative processes between participated partners as in Figure 4-18.

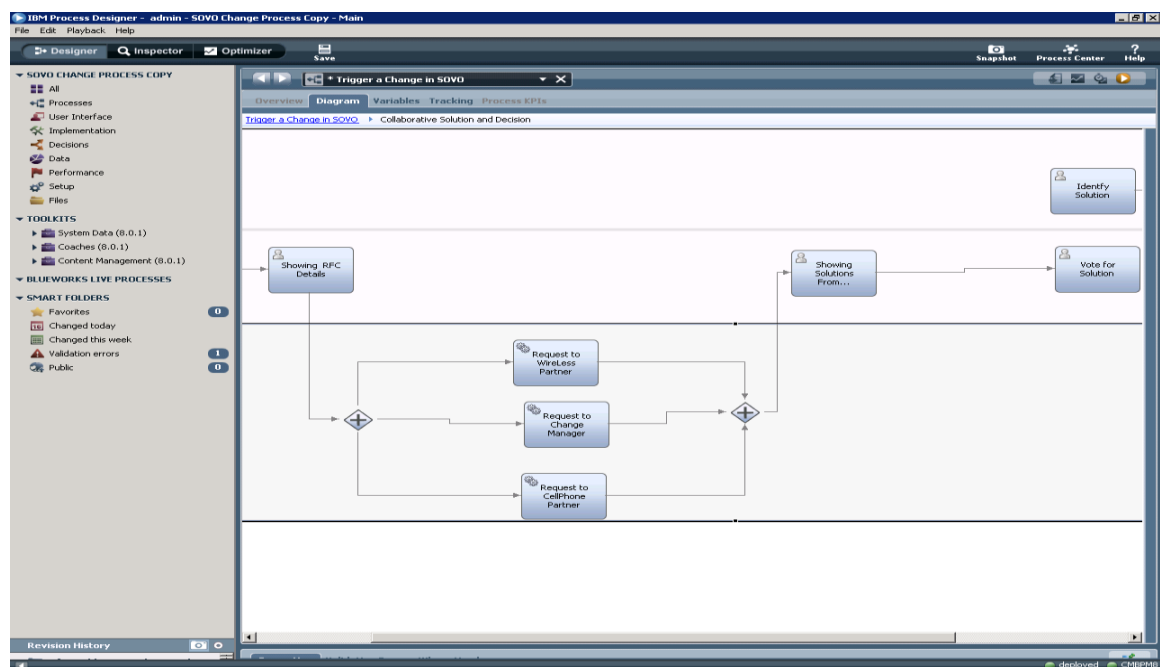


Figure 4-18: Collaborative process in the communication and collaboration layer

The integration of the communication and collaboration layer collaborative processes with the submit solution services is done in the IBM BPM Integration designer. As such, the change process is calling the submit solution service where partners submit their solutions. The service is published as a web service and each partner can submit solution through using it. Partners' submitted solutions are imported into the BPM integration designer and used in the collaborative processes. Figure 4-19 shows a sample of the integration used in the integration designer.

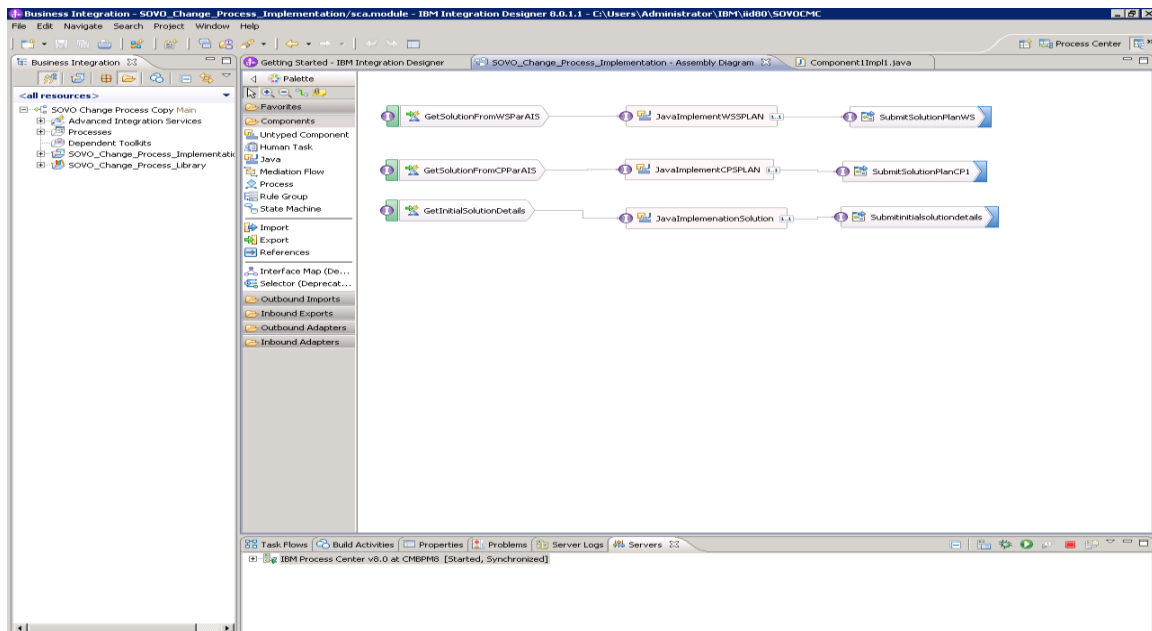


Figure 4-19: The integration designer

We develop the VO Change Management Console using both the IBM BPM business space and process portal. The business spaces is a browser based Web 2.0 user interface component which serves as a portal for the change process. Using the business space, the VOWireless CAB members, change manager and partners have an access to monitor the performance of the VO and the performance of the shared services through the IBM Cognos BI as illustrated in Figure 4-20. Furthermore, they can initiate the process of change and follow the progress of their RFC.

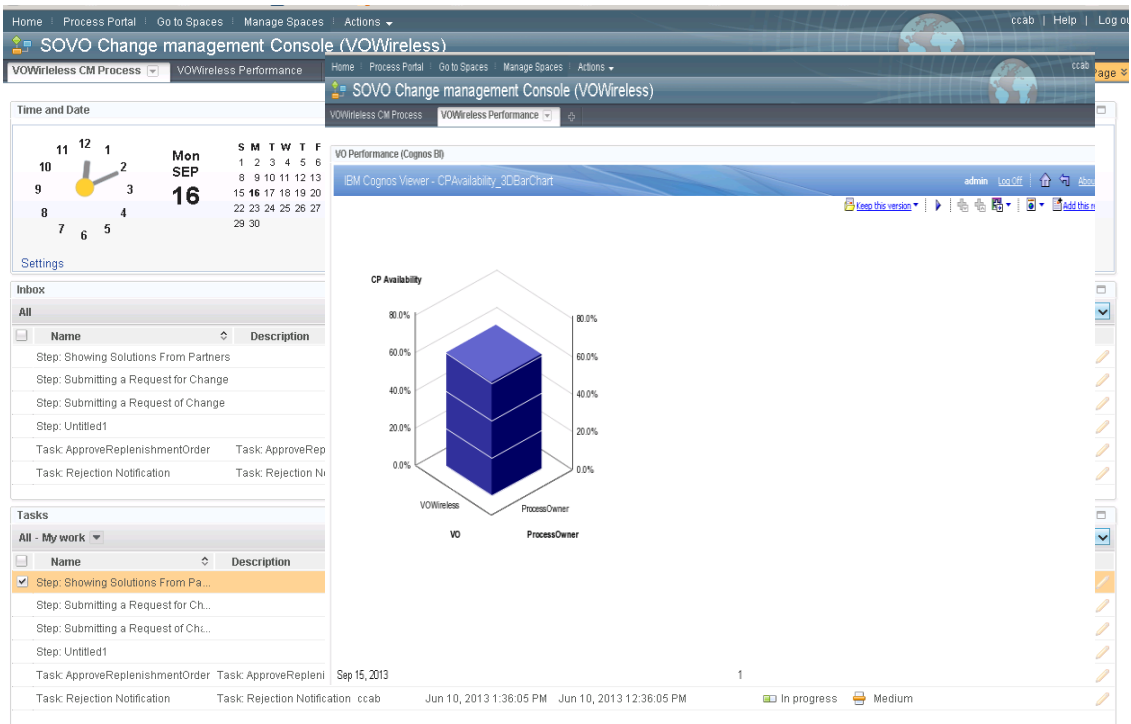


Figure 4-20: The CM Console (Business Space)

The process portal allowing change management participated to go through the process of change, and support the process of collaboration and communication as illustrated in Figure 4-21. The Change Management Console relies on both the business space and the process portal to achieve its goals and objective.

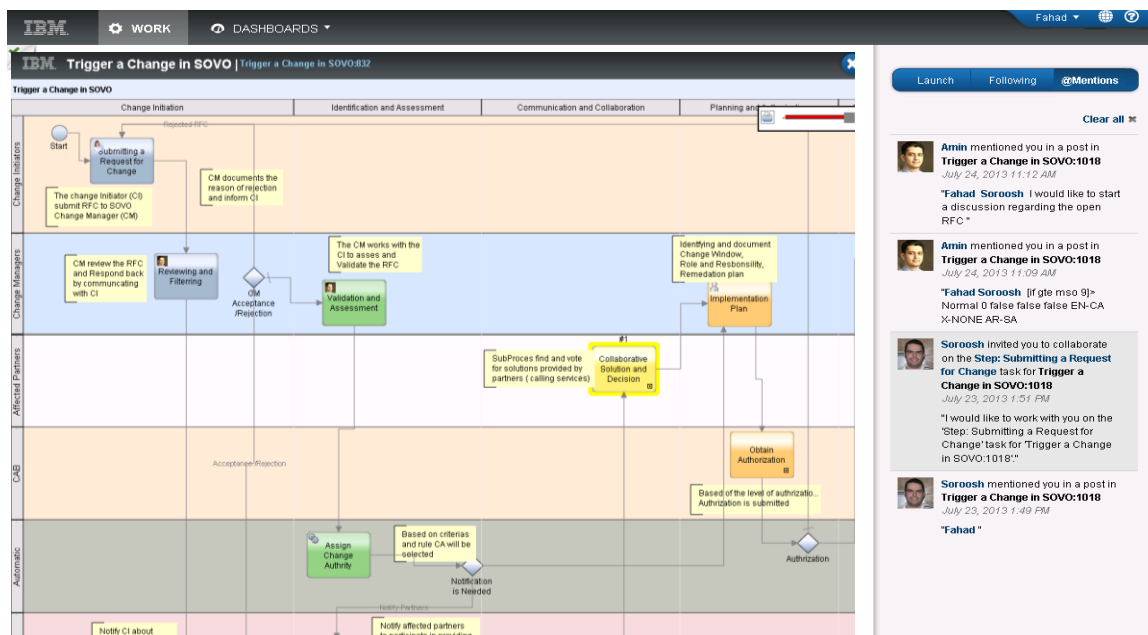


Figure 4-21: The CM Console (Process Portal)

The architecture of the change management console is shown in Figure 4-22. The process portal and the business space are connected together, which allow more flexibility in moving between them.

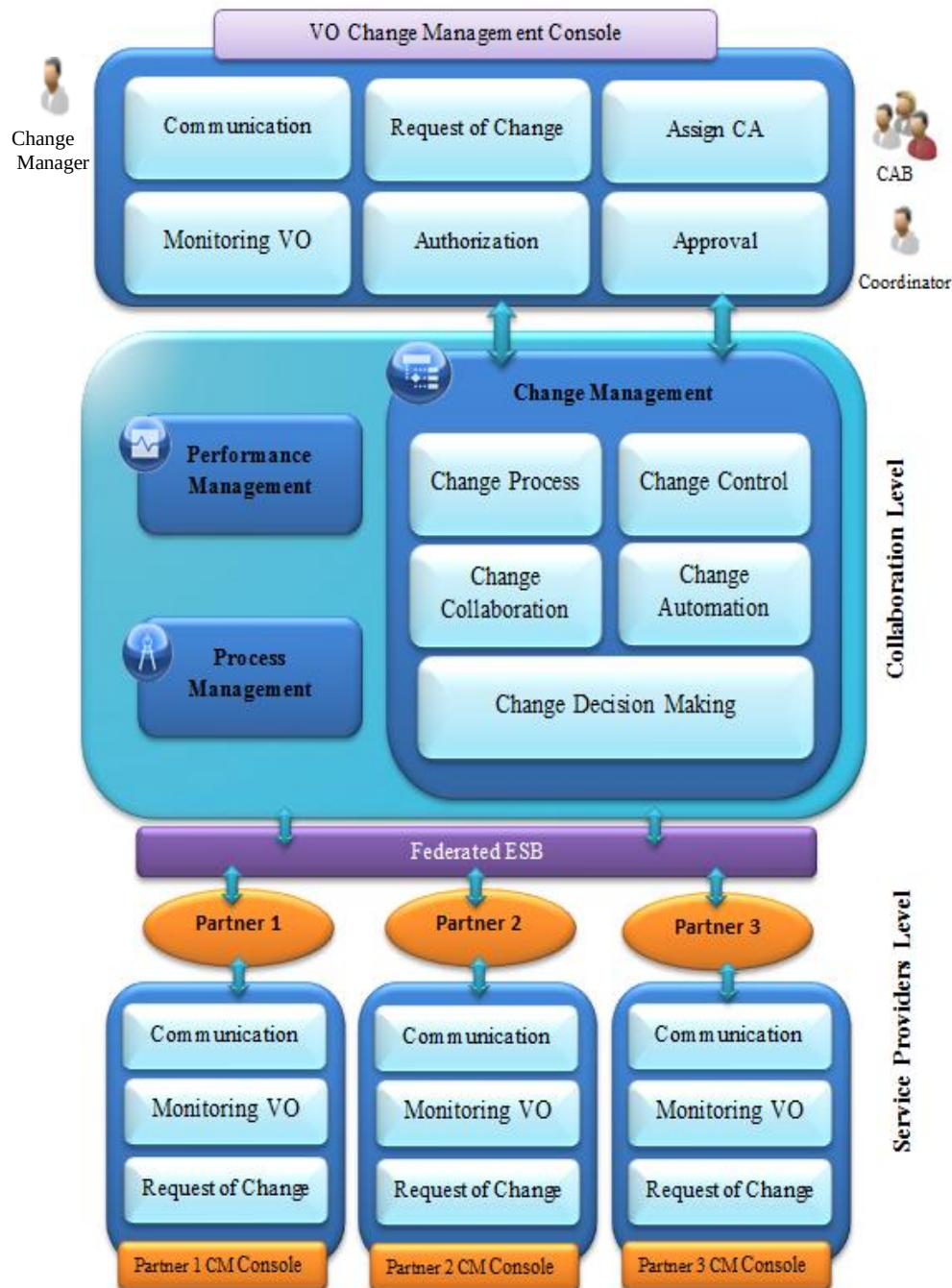


Figure 4-22: The CM Console Architecture

We use the IBM Websphere integrated solutions console to set up the change management groups and build up their profiles. Figure 4-23 shows the change management groups configured in the integrated solutions console.

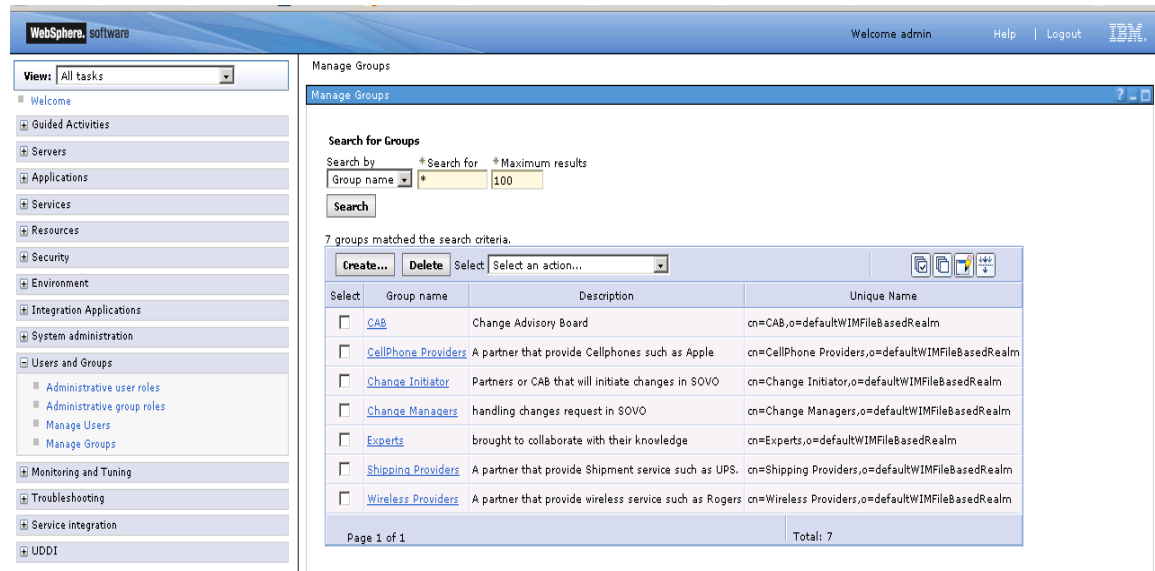


Figure 4-23: Websphere Integrated Solutions Console

4.4 Analyzing the Proposed Framework and Implementation

The proposed change management framework including *the structural* and *procedural* frameworks are evaluated based on descriptive and experimental methods. In the descriptive method, we provided different change management scenarios which are conducted to demonstrate the utility if the proposed solution. Two details scenarios were provided where changes triggered at different levels of change in the SOVO to demonstrate how the proposed change management solution can respond and deal with these changes. In the experimental method, a prototype of the proposed solution was implemented using the IBM products to demonstrate the utility of the change management framework in the SOVO environment.

We also conduct an analytical approach to evaluate our proposed solution. Table 4-4 includes a breakdown of the main construct, the operational concepts, their required criteria and meaning, the solutions proposed to meet the criteria compared to the solutions undertaken by a physical (Single) organization to meet these criteria. For the SOVO change management framework, we identify three operational concepts which are required for a successful change in SOVO. The three operational concepts include the

change management processes, change management procedures and change management collaboration. For each operational concept, we identify different criteria which the proposed solution (for VO environment) needs to meet for the success of the operational concept. For example, decision making is important for the success of the change management collaboration. In our SOVO change management proposed solution, we used a voting tool between distributed partners to meet this requirement. Whereas, physical (single) organization usually has a centralized decision making process.

Table 4-4: The SOVO Change Management success criteria

<i>Construct</i>	<i>Operational Concept</i>	<i>Criteria</i>	<i>Meaning</i>	<i>Solution</i>	
				<i>SOVO</i>	<i>Physical (single)</i>
Business Process and Service Change Management	Change management procedure	Change impact	What is the effect of change	Identify the effect of change on each layer of change in the structural framework (predefined)	Using configuration items to anticipate the effect of change
		Change severity	The overall risk associated with a change	Identifying the value object depth of influence	Identified based on the scope of change
		Change Root-cause	The party responsible for triggering the change	Identified triggers of change	Known triggers of change
				Responsibility zone	Investigate the cause of change
		Change propagation	Change cascade into different value objects	The change impact zone helps in identifying the change propagation	Analyzing the change impact to understand the change propagation

		Roles and responsibilities	Identify the role and responsibilities of people in the change process	Responsibility matrix	Responsibility matrix
		Change Authority	The people responsible for authorizing a change	Levels of change	Determined by the organization stakeholders
	Defined by VO coordinator				
	Change management process	Flexibility	The early ability to respond to internal or external changes	Escalation process	Escalation process
		Automation	The ability to automate the process between partners	Using BPM	Change management system, which could be a complicated process
		Timeliness	Time it takes to make a change from triggering the change until implementing the change	Number of days/hours/minutes	Number of days/hours/minutes

		Usability	The quality of the change process to provide better service	Meets KPI	Defined internal KPIs between department
	Change Management Collaboration	Collaborative process	Partners submit their solutions in a collaborative manner	Submit solution service	Not applicable
		Partners Discussion	Partners communicate and discuss the problem	Social toolbar	E-mail, Face to face
		Real-time	Provide real-time collaboration between partners	Form collaboration	Not applicable
		Commitment	Partners willingness to avoid critical situations	pro-active and re-active commitment	Single organization
		Decision making	Choosing the most feasible solution	Voting tool	Centralized decision

4.5 Observations and Recommendations

In this research, we employed the IBM Business Process Manager (BPM) advanced to implement the prototype of change management process. The IBM BPM advance V7.5.1 has a social toolbar which can be used to communicate the process of change between partners in a collaborated manner. The IBM has released a plug-in to activate the social aspect in the IBM BPM V7.5.1, but the plug-in did not work. After investigating the problem, we found out that the IBM BPM V7.5.1 has some bugs in activating the social

toolbar, and most the IBM online communities recommend to migrate to the IBM BPM 8.0.1. For this reason, we had to migrate from the IBM BPM advanced V7.5.1 to the IBM BPM advanced V8.0.1 with the social capability.

Our proposed change management implementation relies on the SOVO performance management implementations to trigger changes and evaluate the performance of implanted changes. For this reason, we had to work with the performance implementations, which include working with the IBM Business Monitor, Cognos BI, Cognos Framework Manager, Cognos Transformer and Cognos Report Studio.

Chapter 5 : Conclusions

5.1 Summary of the Research

Service Oriented Virtual Organizations (SOVOs) are evolving by restructuring and changing their business process and services to meet the internal and external requirements of the competitive, complex and rapidly changing environment they operate in. With a prior knowledge of the changes, and well-defined change processes, the VOs participated organizations can respond quickly and flexibly to the changes to remain profitable and competitive.

The current literature on the VO evolution indicates that a VO needs to adopt a change management mechanism which enables the VO to survive in the complex and changing business environment. On the same line of thought, we propose a change management framework in the service oriented virtual organizations which includes a *structural* and a *procedural* component.

The *structural* framework categorizes changes in the SOVO into three layers of change, and identifies the impact of change on each layer. The first layer is the *value network* layer where changes affect the VO configuration and topology. The second layer is the *collaborative process* layer where changes affect the VO service choreography. The third layer is the *partners' service* layer where changes affect the level of the services. Furthermore, the structural framework identifies various reasons (triggers of change) which eventually lead to the changes in the SOVO three layers of change.

The *procedural* framework provides step-by-step activities and methods that the VO participated organizations can follow to initiate changes to their business processes and services. The procedural framework is derived from the ITIL V3, ECM and ECOLEAD best practices and recommendations, and customized to fit the service oriented virtual organization environment's change requirements. Employing the proposed framework and methodology to manage changes in the virtual organizations increases the flexibility, agility, competitive advantage and the value added to their services.

5.2 Contributions of the Research

We contribute to the virtual organization's evolution phase by facilitating the process of change between participating organizations, which offers effective change control, change collaboration and change automation.

We identified the levels of changes in the SOVO with their impact on the VO participating organizations and their collaboration. The levels of changes are projected in the SOVO environment which include value network changes, collaborative process changes, and service providers' changes. Furthermore, we identified the triggers of business processes and services changes in the SOVO. This includes various reasons that justify why a VO initiates changes to its shard business processes and services. The levels of change and the triggers of change combined together to form the *structural* framework of the change management.

We designed and developed a change management *procedural* framework which provides step-by-step activities and methods that the VO participated organizations can follow to initiate changes to their business processes and services. The procedural framework is derived by adopting the ITILv3, ECM and ECOLEAD best practices and recommendations tailored to the changes in the Service Oriented Virtual Organizations. Furthermore, in the procedural framework, we introduced a method to determine the severity of change, and the possibility of its propagation. We identify a method to help to determine the change impact, urgency and priority.

In summary, we list our contributions as follows:

1. Developing the structural framework which includes:
 - Identifying the levels of changes, and the impact of changes at each level.
 - Identifying the triggers of changes in the SOVO.
2. Developing the procedural framework which includes:
 - The six layers of change process.
 - Change control procedure and activities.
 - Identifying the severity of change using the value dependency graph method.
 - Identify the change impact zone and the possibility of its propagation.

5.5 Publications Resulted from this Research

The following publications resulted from this research:

- 1- Obidallah, W., Raahemi, B., Kamali, S. A., & Danesh, M. (2013). Service oriented virtual organizations: A service change management perspective. In *Proceedings of the 26th IEEE Canadian Conference on Electrical & Computer Engineering (CCECE)* (pp. 0–5) May 2013.
- 2- Waeal Obidallah, Bijan Raahemi, S.M.Amin Kamali, Mohammad Hossein Danesh, Soroosh Sharif “Business Process and Service Change Management in Service Oriented Virtual Organizations”, Poster presentation in *CASCON2012*.

5.3 Limitations

The proposed change management framework and the implemented prototype have some limitations. The change management procedural framework has interfaces with different management processes which were briefly explained in our work, but it needs further investigation. There is an assumption in this work which is related to the concept of the VO, that each VO partner is autonomous and committed to collaborate to the extent to help other VO partners become successful in what they do. This could be challenging in a real life scenario unless the partners maintain a mutual trust and strong communications among them.

The change management scenarios can be generalized to demonstrate the usage and the utility of the proposed framework. The scenario used in this research based on two partners who collaborate in VOWireless, and when changes happen, a third partner is added to the VO. This scenario indicates a real life case scenario which has been implemented in our Lab environment to demonstrate how the change management proposed solution facilitate the process of change. Different scenarios can be used to demonstrate the utility of the proposed solution.

With regard to the implemented prototype, we employed the IBM BPM V8.0.1 with its social and Web2.0 capability to implement the change process. However, there are other tools available which provide full social BPM capabilities, which is suitable in the collaborative environments such as the SOVO. During the voting process in the

collaboration and communication layer, we considered the percentage of voting to decide the feasible solution, whereas, other criteria can be used to decide the right solution.

5.4 Future Works

A change decision making framework in the SOVO environment can be a continuing research area. Furthermore, creating an ontology that describes the structure of change, the concepts and the relation between different management processes for evolution in the SOVO will be useful. Change propagation analysis between the VO levels of change can provide a solid contribution to the evolution of the VO.

Some of the components mentioned in this thesis including the problem management, release management and configuration management in the SOVO environment can be further studied in the future research. We can also expand our work to include the VO evolution phase by identifying its requirements where change management is one of them.

Appendices

Appendix A: The flow chart of change management process in the SOVO

The following flow charts illustrate the propose solution (procedural framework) to facilitate the process of the change in service oriented virtual organizations. The process of change starts with a trigger of change which leads to the request of change.

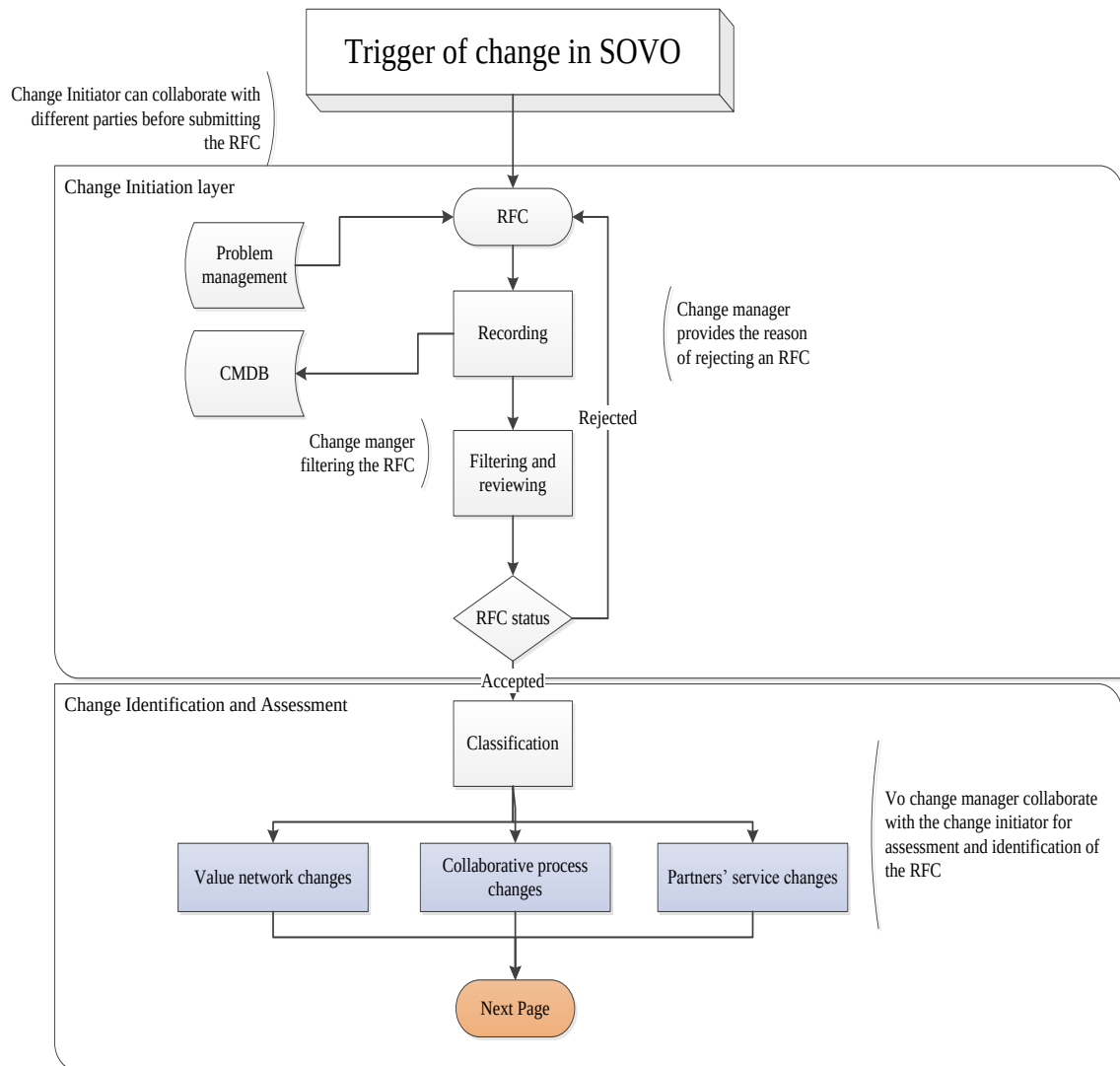


Figure A- 1: Change Initiation, Identification and Assessment

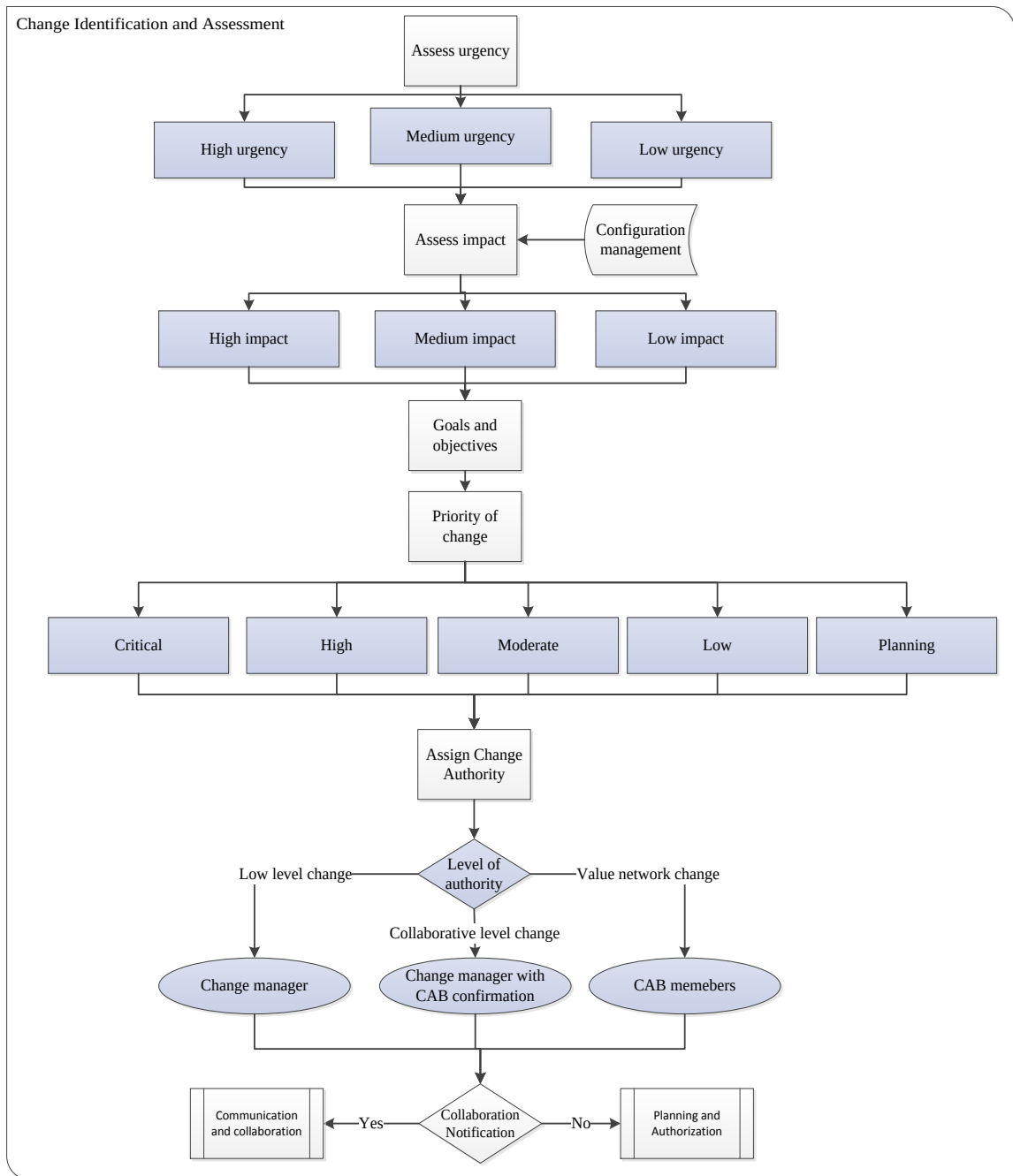


Figure A- 2: Change Identification and Assessment

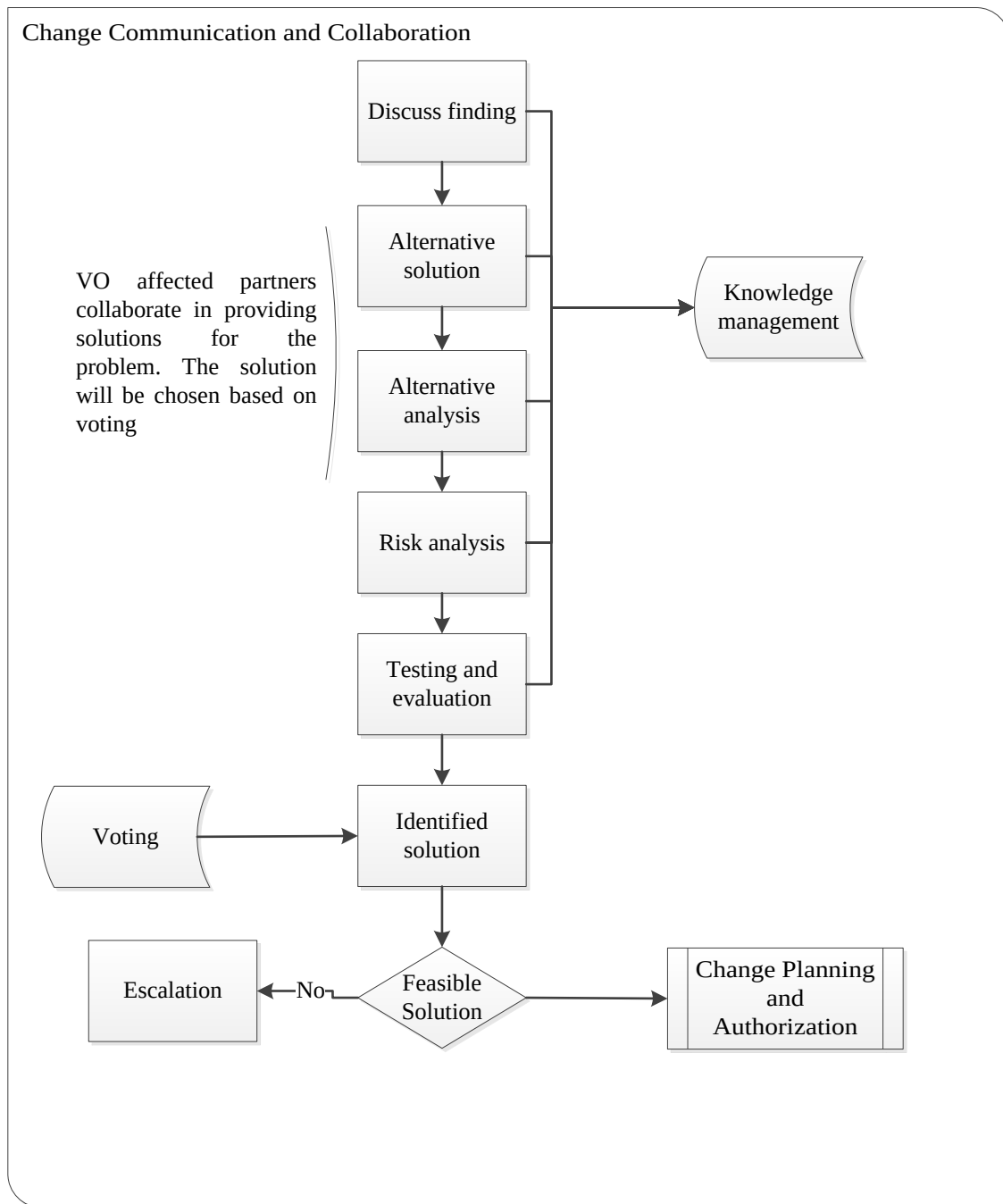


Figure A- 3: Change Communication and Collaboration

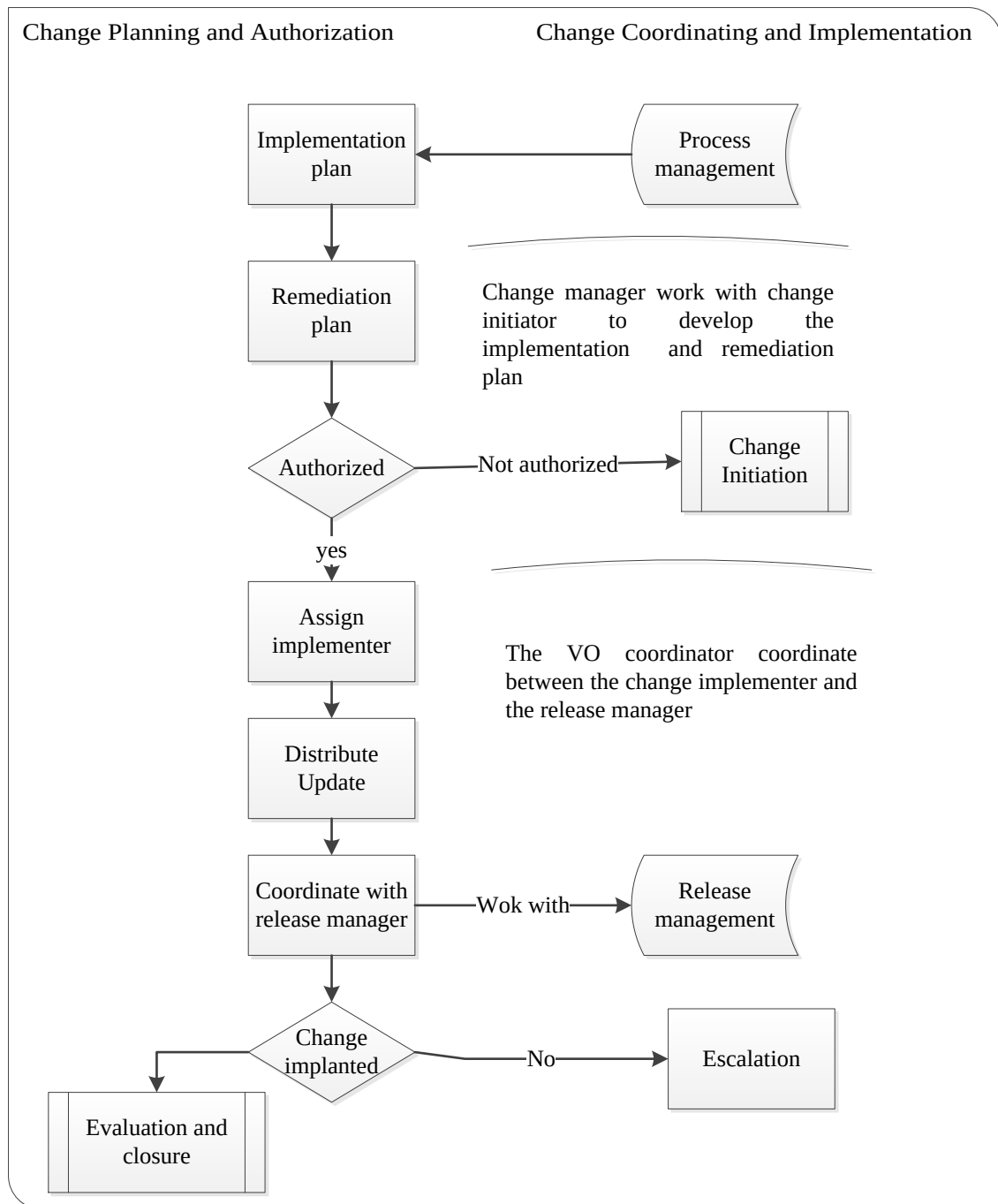


Figure A- 4: Change Planning, Authorization, coordination and Implementation

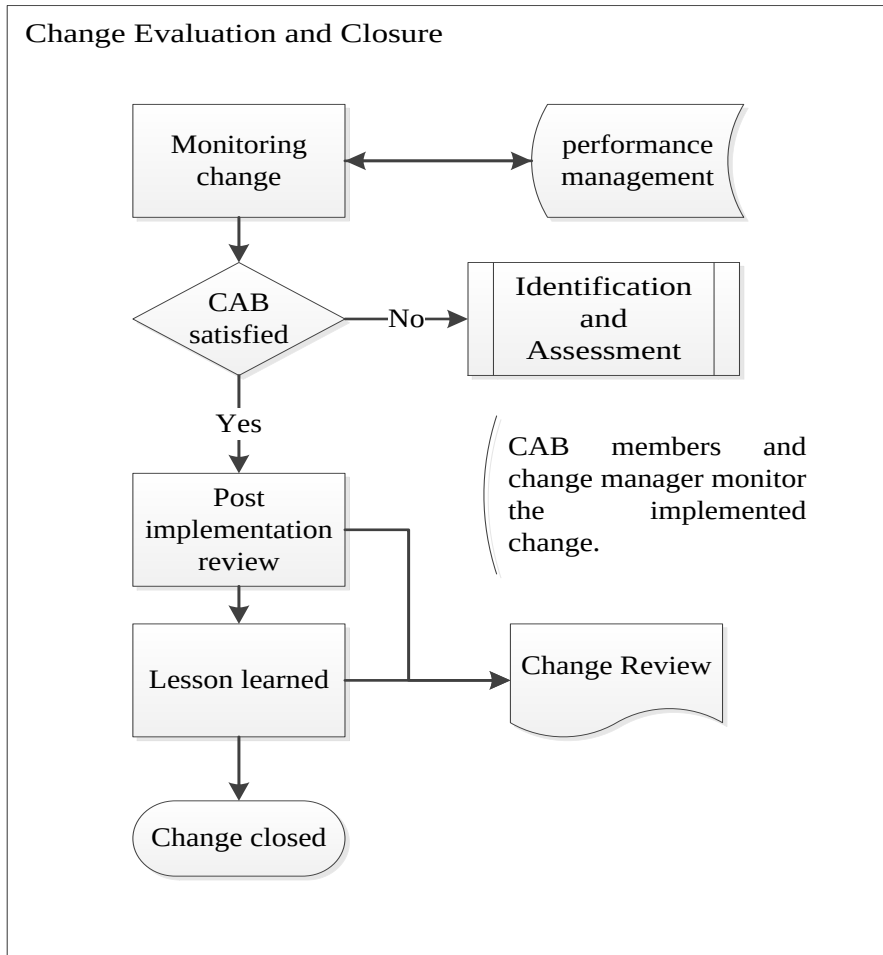


Figure A- 5: Change Evaluation and Closure

Appendix B: The implemented change management process in the IBM BPM

The following illustrates the change management processes as implemented in the IBM BPM Process Designer.

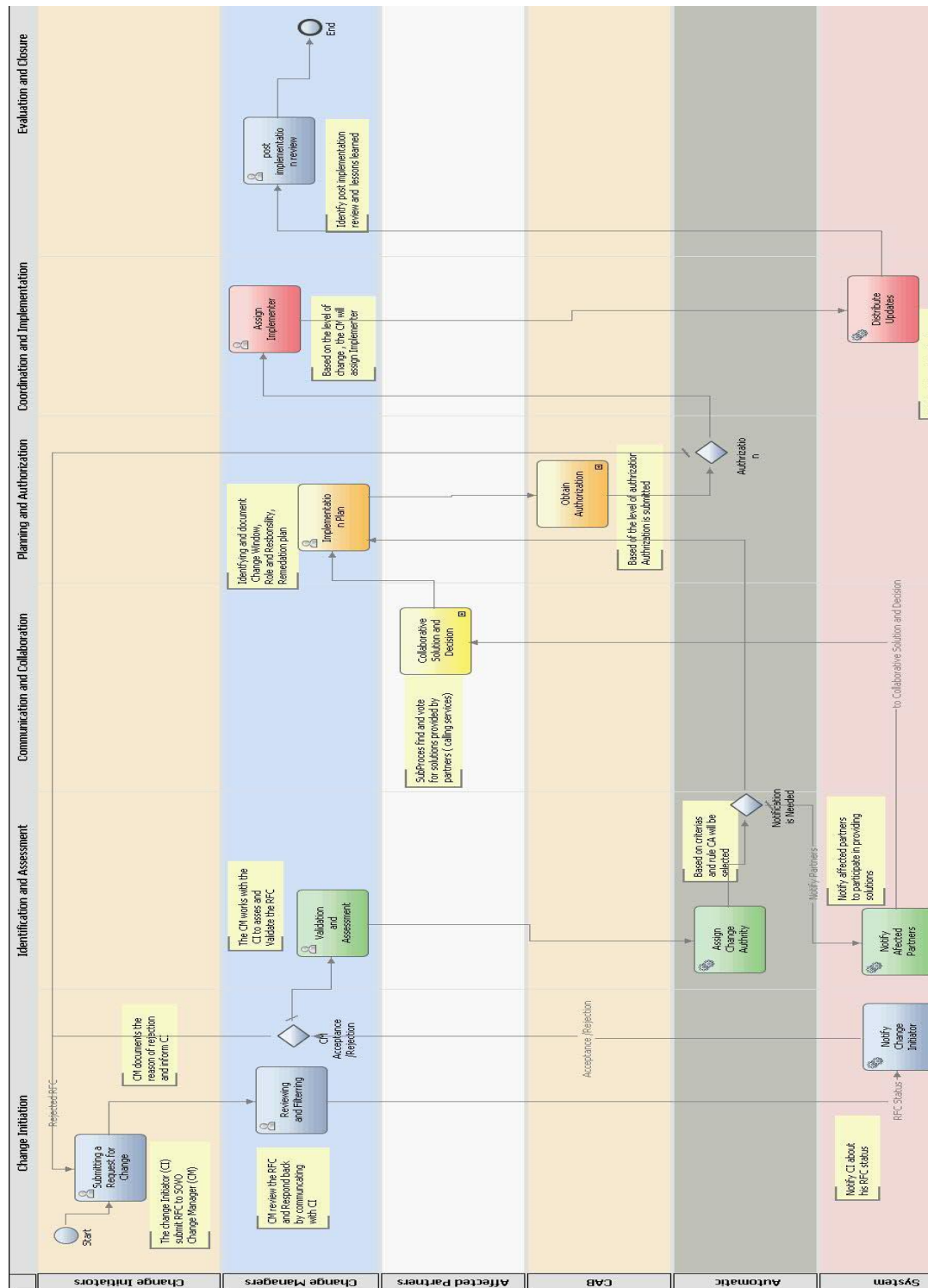


Figure B- 1: The implemented Change Management Processes

Appendix C: The e3value ontology modelling constructs used in the SOVO

The following explains the e3value ontology modelling constructs which has been used to model the value network in the SOVO.

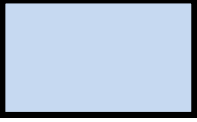
e3value construct	Description
Actor 	An actor is perceived by his/her environment as an economically legal and independent entity. Examples of actors include Store, Wholesaler, and Manufacturer. The SOVO participated organizations (service providers) play the role of the actor in modelling value exchange.
Value Object [...]	Actors exchange value objects between each other. A value object could be a service, a good, money, information or even a knowledge, which has economic value for at least one of the actors.
Value Port △ ▽	An actor uses a value port to provide value object to other actors or to request value objects from other actors. It works as a port between actors where they can use it to exchange value objects.
Value Interface 	An Actor has one or more value interfaces which group value ports and show economic reciprocity. An actor is willing to offer a value object through its value interface, if he/she receives an adequate compensation in return.
Value Transfer 	A value transfer is used to connect two value ports with each other. It represents one or more potential trades of value objects between actors. The transfer of good, product or payment is an example of value transfers.
Market Segment 	A market segment breaks actors into segments of actors that assign economic value to objects equally. It is used to model a large group of end customers who value objects equally and looking to get the final value for their own.
Consumer need 	The flow of value objects triggers at this stage. A consumer need satisfied by exchanging value objects between actors.
Dependency Boundary 	Dependency boundary shows that we do not consider any more value exchanges on the path and the flow of values will rebound towards the consumer.
Connect element	A connection element relates a consumer need to an interface, or relates different interfaces of a same actor.

Table C- 1: The e3value ontology modelling constructs

Appendix D: Automating the social toolbar posts using JavaScript

The following demonstrates a method used to automate the updating posts about the process status on the process portal social toolbar. We used a JavaScript to identify the status of the process and post an update on the post stream of the social toolbar.

Notify and update the RFC status

```
if( tw.local.Status == true){
var comment= " RFC is Accepted"
tw.system.currentProcessInstance.addComment(comment);
}
else if (tw.local.Status== false){
var comment= " RFC is Rejected"
tw.system.currentProcessInstance.addComment(comment);
}
```

Notify if partners collaboration is needed

```
if (tw.local.Notify == true )
{ For comment = " Notifications will be sent to affected partners!";
tw.system.currentProcessInstance.addComment(comment);
}
else if (tw.local.Notify== false){
var ms = " No need to involve other partners for Now!";
tw.system.currentProcessInstance.addComment(ms);
}
```

Notify, update and assign the change authority based on the level of change

```
if (tw.local.Risk.listSelected == "Low"){
Var comment= " Change Authority assigned to Change Manager with an
update to CAB";
tw.system.currentProcessInstance.addComment(comment);
tw.local.ChangeAuthrity= "Change Manager"; }
else if (tw.local.Risk.listSelected == "Medium"){
var comment= " Change Authority assigned to Change Manager with CAB
confirmations ";
tw.system.currentProcessInstance.addComment(comment);
tw.local.ChangeAuthrity= "Change Manager needs CAB confirmations";
}
else if (tw.local.Risk.listSelected == "High"){
var comment= " Change Authority assigned to CAB members";
tw.system.currentProcessInstance.addComment(comment);
tw.local.ChangeAuthrity= " CAB members";
}
else {
var comment= " Change Authority assigned to CAB";
tw.system.currentProcessInstance.addComment(comment);
tw.local.ChangeAuthrity= " CAB ";
tw.local.Risk.listSelected = "High!";
}
```

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).
- Afsarmanesh, H. (2008). VBE reference framework. *Methods and Tools for collaborative networked organizations*, 35–68.
- Akram, M. S. (2005). *Managing Changes to Service Oriented Enterprises*. State University.
- Akram, S., Bouguettaya, A., Liu, X., Haller, A., & Rosenberg, F. (2010). A change management framework for service oriented enterprises. *the international journal of next-generation computing*, 1(1).
- Allee, V., & Schwabe, O. (2011). *Value Networks and the true nature of collaboration*. ValueNet Works Verna Allee Associates.
- Andrikopoulos, V., Benbernou, S., & Papazoglou, M. P. (2008). Managing the Evolution of Service. In *Proceedings of the 20th Int'l Conference on Advanced Information Systems Engineering* (Vol. 5074, 2008, pp. 359–374).
- Ashtiani, M. A. D. (2012). *Design and Implementation of a Framework for Process Management in Service Oriented Virtual Organizations Using Service Zones*. University of Ottawa.
- Bianco, P., Kotermanski, R., & Merson, P. (2007). *Evaluating a Service-Oriented Architecture* (p. 91).
- Bloor, R., Hurwitz, J., Kaufman, M., & Halper, F. (2009). *Service oriented architecture for dummies* (p. 76). Wiley.
- Bon, J. Van, Jong, A. de, & Kolthof, A. (2007). *Foundations of ITIL V3* (June 2010., p. 31). Van Haren Publishing.
- Camarinha-Matos, L., & Afsarmanesh, H. (2007). A comprehensive modeling framework for collaborative networked organizations. *Journal of Intelligent Manufacturing*, 18, 529–542.
- Camarinha-Matos, L. M., Afsarmanesh, H., & Ollus, M. (2008). ECOLEAD and CNO base concepts. In *Methods and Tools for collaborative networked organizations* (pp. 3–32). Springer.
- 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* (pp. 12–17). IEEE.
- Danesh, M., & Raahemi, B. (2012). A distributed service oriented infrastructure for business process management in Virtual Organizations. In *Proceedings of the 25th IEEE Canadian Conference on Electrical & Computer Engineering (CCECE)* (pp. 1 – 6). Montreal, QC: Ieee.
- Danesh, M., Raahemi, B., Kamali, S., & Richards, G. (2011). A Framework for Process and Performance Management in Service Oriented Virtual Organizations. *The International Journal of Computer Information Systems and Industrial Management Applications*, 3.
- Dimitrakos, T., Golby, D., & Kearney, P. (2004). Towards a trust and contract management framework for dynamic virtual organisations. In *In eAdoption and the Knowledge Economy: eChallenges 2004* (pp. 27–29). Kluwer Academic.
- Drissen-Silva, M., & Rabelo, R. (2012). A Model for Collaborative Decision-Making for the Evolution of Virtual Enterprises. In *Collaborative Networks in the Internet of Services IFIP Advances in Information and Communication Technology* (Vol. Volume 380, pp. 655–663). Springer.
- 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), 4833–4854. doi:10.1080/00207540902847389
- 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* (Vol. 266, pp. 105–114). Springer.
- Dumitraş, T., Roşu, D., Dan, A., & Narasimhan, P. (2007). Ecotopia: An ecological framework for change management in distributed systems. *Architecting Dependable Systems IV Lecture Notes in Computer Science*, 4615, 262–286.
- Erl, T. (2005). *Service-oriented architecture: concepts, technology, and design* (p. 729). Prentice Hall.
- Hevner, A., March, S., Park, J., & Ram, S. (2004). Design science in information systems research. *Jouranl of Management Information Systems quarterly*, 28(1), 75–105.
- Himmelman, A. (2002). Collaboration for a change: Definitions, decision-making models, roles, and collaboration process guide. *Minneapolis: Himmelman Consulting.*, (January).

- Holley, K., & Arsanjani, A. (2010). *100 SOA Questions: Asked and Answered* (p. 304). Prentice Hall.
- Jansson, K., & Eschenbaecher, J. (2005). *Challenges in Virtual Organisations Management—Report on methods for distributed business process management* (pp. 1–127).
- Jansson, K., Karvonen, I., Ollus, M., & Negretto, U. (2008). Governance and management of virtual organizations. In *Methods and Tools for collaborative networked organizations* (pp. 221–238).
- Jarratt, T. a. W., Eckert, C. M., Caldwell, N. H. M., & Clarkson, P. J. (2011). Engineering change: an overview and perspective on the literature. *Journal of Research in Engineering Design*, 22(2), 103–124. doi:10.1007/s00163-010-0097-y
- Jong, A. de, Kolthof, A., Pieper, M., & Bon, J. Van. (2008). *ITIL V3 Foundation Exam: The Study Guide* (p. 245). itSMF International.
- Kamali, S. M. A. (2013). *Design and Implementation of a Framework for Performance Measurement in Service Oriented Virtual Organizations*. University of Ottawa.
- Kamali, S. M. A., Richards, G., Danesh, M. H., & Raahemi, B. (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, Jansson, K., & Salkari, I. (2004). Challenges in the management of virtual organizations. *Virtual enterprises and*.
- Karvonen, Iris, Jansson, K., Salkari, I., & Ollus, M. (2004). Challenges in the management of virtual organizations. *Virtual Enterprises and Collaborative Networks- IFIP International Federation for Information Processing*, 149, 255–264.
- Karvonen, Iris, Salkari, I., & Ollus, M. (2005). Characterizing Virtual Organizations and Their Management. In *Collaborative Networks and Their Breeding Environments* (Vol. 186, pp. 193–204). Springer Boston.
- Keller, a. (2005). Automating the Change Management Process with Electronic Contracts. In *Proceedings of the 7th IEEE International Conference on E-Commerce Technology Workshops* (pp. 99–108). Ieee. doi:10.1109/CECW.2005.7
- Kort, C., & Gordijn, J. (2008). Modeling Strategic Partnerships Using the E3value Ontology: A Field Study in the Banking Industry. In *Handbook of ontologies for business interaction* (pp. 310–325).

- Liu, X., & Bouguettaya, A. (2007). Reacting to functional changes in service-oriented enterprises. In *Proceedings of the International Conference on Collaborative Computing: Networking, Applications and Worksharing*. (pp. 264–270). IEEE. doi:10.1109/COLCOM.2007.4553840
- Negretto, U., Hodík, J., Král, L., & Mulder, W. (2008). Vo Management Solutions VO Management e-Services. In *Methods and Tools for collaborative networked organizations* (pp. 257–274). Springer.
- Obidallah, W., Raahemi, B., Kamali, S. A., & Danesh, M. (2013). Service oriented virtual organizations: A service change management perspective. In *Proceedings of the 26th IEEE Canadian Conference on Electrical & Computer Engineering (CCECE)* (pp. 0–5). IEEE.
- Object Management Group. (2011). *Business Process Model and Notation (BPMN)*. Object Management Group (p. 538).
- OGC. (2007a). *The official introduction to the ITIL service lifecycle* (p. 252). United Kingdom:: TSO (The Stationery Office).
- OGC. (2007b). *Service transition* (p. 274). United Kingdom:: TSO (The Stationery Office).
- Ola, H. A., Rogalski, S., Krahtov, K., Stanev, S., Krappe, H., & Ovtcharova, J. (2008). Efficient change management for the flexible production of the future. *Journal of Manufacturing Technology Management*, 19(6), 712 – 726.
- Peffer, K., Tuunanen, T., Rothenberger, M. a., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, 24(3), 45–77. doi:10.2753/MIS0742-1222240302
- Rabelo, R., & Gusmeroli, S. (2008). The ECOLEAD collaborative business infrastructure for networked organizations. In *Pervasive Collaborative Networks IFIP – The International Federation for Information Processing* (Vol. 283, pp. 451–462). Springer.
- Romero, D., & Molina, A. (2009). VO breeding environments & virtual organizations integral business process management framework. *Journal of Information Systems Frontiers*, 11(5), 569–597. doi:10.1007/s10796-009-9195-7
- SASIG. (2009). *VDA-ECM Recommendation (ECM)* (p. 155).
- Swarnkar, R., Choudhary, a. K., Harding, J. a., Das, B. P., & Young, R. I. (2011). A framework for collaboration moderator services to support knowledge based collaboration. *Journal of Intelligent Manufacturing*, 23(5), 2003–2023. doi:10.1007/s10845-011-0528-2

- Tripathi, U. K., & Hinkelmann, K. (2007). Change management in semantic business processes modeling. In *Proceedings of the Eighth International Symposium on Autonomous Decentralized Systems* (pp. 155 – 162). IEEE.
- 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* (pp. 1–6). New York, New York, USA: ACM Press. doi:10.1145/1943628.1943668
- Wang, H., Zhang, W., & Ge, Y. (2010). Service information management framework based on SOA. In *Proceedings of the 3rd IEEE International Conference on Broadband Network and Multimedia Technology (IC-BNMT)* (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* (pp. 75–82). Ieee. doi:10.1109/APSCC.2010.18