Governance as a Service for Collaborative Environment

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Abstract. In a highly competitive and collaborative network environment, enterprises have to focus on their core competencies and to increase internal and external collaboration to provide more efficient services to meet various needs of markets. However, governance is still one of the most important challenges for collaborative enterprises. Some studies on collaborative networks just focus on technological aspects, often neglecting other business related issues. Business process management, performance management and business process alignment are key questions to be solved to increase the global synergy of the Collaborative Organization. In this paper, we propose to extend the traditional XaaS model to the Business Layer and propose a flexible, efficient collaborative governance framework: Governance as a Service framework (GaaS) which supports dashboard mashups and autonomous strategy to govern globally the collaborative environment.

Keywords: collaborative environment; SOA; autonomic computing; mashups.

1   Introduction

In a highly competitive, globalized economies and collaborative network environment, the business landscape has changed dramatically and technologies are rapidly improved. To meet the new requirements of users and to survive in today's turbulent market conditions, comprising various heterogeneous entities with different competences, enterprises have to focus on their core competencies and to set collaborative strategies to provide more complex services and outstanding products fitting the markets needs. Developing Collaborative Networked Organizations (CNOs) is a way to achieve agility and increase operation efficiency and resources productivity and as a consequence increases the call for adapted governance environments to measure the success of these collaborative environments.

Some studies on business efficiency lack of paying attention neither to collaborative networks nor to the implementation layers whereas other studies focus on technological Quality of Service issues, neglecting other issues, such as business aspects within collaborative networks. To overcome this limit, our Business performance management and technical performance management framework is based on a multi-dimension approach on CNO (technological, social, semantic and business perspective).

This paper is organized as follow: after presenting the context and the related works (section 2), we extend the traditional XaaS model to the Business layer and propose a flexible, efficient, low cost collaborative Governance as a Service (GaaS) framework, taking advantage of autonomic computing and mashups technology to support agile and adaptive dashboards management (section 3).

2   State Of The Art

As a result of globalization, CNOs are strengthening their internal and external cooperation ability, look for improving their performance in different aspects such as increased inventory turnover, increased revenues, cost reductions, product availability, and economic value added [1]. Despite their economical interest, several factors (such as lack of top management support, cross-functional conflicts, lack of trust, etc) still limit effective collaboration [2] and may lead collaborative initiatives to fail [3], [4].

As CNOs performance level depends on both its internal organization and on each partner own performance level, it is necessary to identify and measure the inner-enterprise and external-enterprise performance elements and being able to manage effectively collaborative relationships [5]. Most of the existing Performance Measurement Systems (PMSs) are not designed to manage and improve enterprises' activities. Various barriers (decentralized organization, uncertainty, dispersed IT infrastructure, etc) obstruct collaborative governance development [6], [7]. In their survey, [2] gave an extensive literature review on monitor and control performance of Virtual Enterprises (VE) and Extended Enterprises (EE). They pointed out there was not a framework fully accomplished to monitor VE and EE and their proposal (a PMS for VE and EE (PMS-EVE)) lacks of ability to control business activities. Even if [8] presents a model and a performance measurement system for collaborative supply chain (CSC), it does not to fit complex collaborative environment nor improves the CSC performance. According to a rather technical point of view, the DMTF new Architecture for Managing Cloud takes service as a black box for managing and does not pay attention on the business perspective nor address how to build management function in a cloud [9].

This review shows that most of PMS do not support a dynamic management organization. Only few of them integrate Management Information System (MIS) features but without considering the links between top management organization and specific IT infrastructure [10]. To overcome these limits [11]. combine change management and MIS specialists in the context of globalization, servitization and networking in multi-cultural environment. Using efficiently distributed data, it still lacks of reactive abilities.

These limits are quite similar to those encountered in a biological system [12] (having to face efficiently the changing environment, being self-adaptive, self-organized, robust and allowing distributed and parallel computation as well as self-learning). Immunologically inspired strategies have been successfully used in computer and internet security [13] as it helps to answer automatically, to resolve problems, security threads and system failures in collaborative environment [14].

To overcome existing PMSs limits, we propose a flexible and agile Governance as a Service framework extending the traditional XaaS model to the Business Layer. Fitting the CNOs performance requirements (dynamicity, management of multiple dimensions…) it takes advantage of mashups to define adaptive dashboard.

3   Contribution

Our governance framework aims to meet the needs of collaborative enterprises, to improve the culture of openness, sharing ideas thus enhancing flexibility in business processes and innate ability to embrace innovation both inside and outside the organization. Due to the geographical distribution of collaborative enterprises, our Governance as a Service framework deploys local key performance indicator to govern performance of each participant organization and activates local action engines to reduce wastes and errors. We also build a cross-platform virtual resources repository to share governance information and make full use of existing resources to establish mashup-based dashboards and improve the efficiency of display governance reports. It consists in 4 components: Interaction Window; Mediator Component; Govern & Act Component; Resource Repository. Even if each component can be geographically distributed according to users' needs, they all closely collaborate with each other to comprehensively monitor the performance of collaborative environment. (See figure 1)
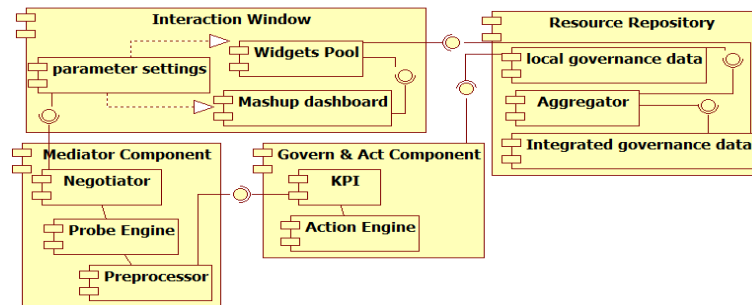

Fig. 1. Overview structure of Governance as a Service framework

3.1   Components and working principle of GaaS

As said previously, our framework consists in 4 main components:
- **Interaction Window (IW).** It includes Parameter Settings (IW-PS), widgets Pool (IW-WP) and Mashups Dashboard (IW-MD). The Widget pool (WP) includes all widgets that can be chosen by users to be displayed in their mashup-based dashboard. Widgets pick data from shared data repository.

- **Mediator Component (MC).** It includes Negotiator (MC-N), Probe Engine (MC-PE) and Preprocessor (MC-P). This component extends the adaptability of GaaS to make it can fit any enterprises without technical and organizational limits. MC-N negotiates with the monitored organizations to establish specific agreements. Then the mediator Probe Engine (MC-PE) establishes a governance connection with collaborative enterprise. MC-P synchronizes business processes and converts data format for follow-up governance processes.
- **Govern & Act Component (G&A).** It includes KPIs and Action Engines (AEs). According to the feature of collaborative enterprise, as business participants could be geographically distributed, KPIs are deployed into each participant organization and information system to govern its performance and activate AEs to improve enterprise's ability of self-optimizing. After that, all governance and action information is stored into a shared data pool.
- **Resource Repository (RR).** It is a geographically distributed resource repository. All resources in it closely collaborate. It includes local data from KPIs and AEs, Aggregators (RR-A) aggregate scattered governance results into comprehensive results, and save them to the integrated data pool. All shared data and resources can be used to build customized governance result displayed by the widgets.

The working principle of our collaborative governance architecture is shown figure 2:

- Users set parameters for governance;
- Mediator Component negotiates with monitoring participants to establish governance connecting and sign agreements for each participant, then preprocess business information for follow-up governance processes;
- Deploy KPIs and AEs to govern and act for each monitoring participant, save results to shared data pool;
- Aggregators analyze and aggregate scattered data into comprehensive governance results and save to integrated data pool;
- According to users' requirements, widgets pool picks useful resources from resource repository to build widgets can be chosen by users. Mashups dashboard can be flexibly organized by users.

3.2 KPI & AE Self-management

KPIs are associated with Non-functional Properties' (NFPs) definition. Our governance framework can assign and deploy KPIs to collect performance information in a cross-platform organization. Due to the complexity and dynamicity of collaborative environments, KPIs and AEs should be updated continuously to make governance framework works efficiently.
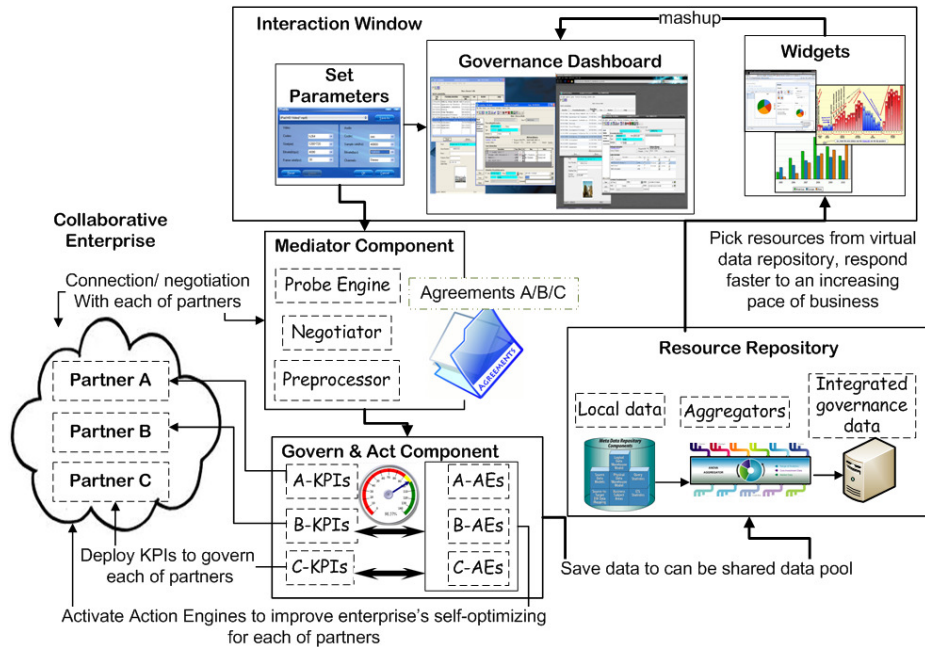
Fig. 2. Working principle of collaborative governance architecture

We design this KPIs' self-evolution and self-management strategies, according to the principles taken from the artificial immunity system. This self-management system aims at improving governance framework's intelligence and flexibility by:

- Defining all wastes and causes of defects as antigens and listing them in a "black check list" while all performance requirements are defined as selfs and listed in a "white check list");
- Defining Action Engines as antibodies;
- Measuring KPIs distance between operation performance and the check list by activating the involved antibodies;
- Identifying any EA operation as self or antigen.

KPIs and AEs collaborative working sequence is shown in the following figure. KPIs govern enterprise's performance and measure distance between performance and check lists. Once any KPI is required, it is given a basic activity value: a. If KPIs measuring the performance belongs to the self set, and then the KPI's activeness decreases 1 point. Otherwise, if the performance belongs to antigen set then KPI's activeness increases 1 point. At the same time, KPI activates the involved AE to eliminate waste and cause of defect. (See figure 3)

As the internal relationship of immunity system, antibodies dynamically change their populations according to the populations of antigens, thereby changing the immune network structure. In our governance framework, populations of AE are self-adapted on the basis of KPIs detected antigens' populations. We design 4 life phases of KPI and AE (see figure 4). KPI's lifecycle directly affects AE's:

- Required: KPI is required by governance framework, AE is required by KPI. KPI and AE is given basic activeness value (a/ae-a);

- Activate: KPI or AE's high active period. Activeness value is changing during the governance processes. When the activeness value is greater than the Activate threshold, KPI/AE' life is going to this activate period from the required period;
- Decline: KPI or AE's activity gradually decreased, and no longer meet the new demands of governance. When activeness value is less than Decline threshold, KPI/ AE's life is in decline period from activate period;
- Updated: KPI or AE is updated to meet the new demands of governance. When activeness value is less than Update threshold, KPI/AE's life is going to update period from decline period, then after update, KPI/AE can be required again.
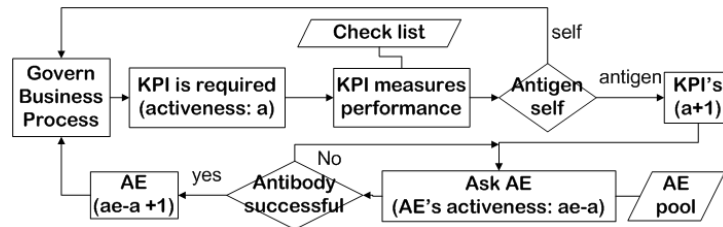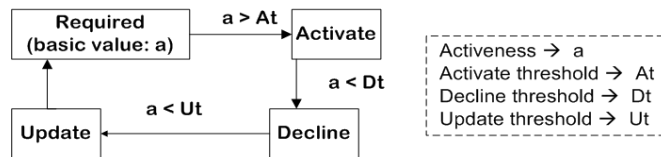

Fig. 3. KPI & AE working sequence

Fig. 4. Lifecycle of KPI and AE

This immunity-based simulation can establish an autonomic and collaborative governance environment. It can provide a low-cost, high efficiency and adaptive governance effect for collaborative enterprises.

Using theory of dynamic immune algorithm to control population of KPI and AE, keeps GaaS' high efficiency and autonomic management. Our autonomous governance strategy gathers all business processes Performance indicators in All Performance (AP) set. Each of them is described by name, distance and attributes. For each performance of business operation, its distance value comes from the measurement of KPIs. If the performance meets the non-functional requirements then its distance is 0, we define it belongs to Self Set (Self). Otherwise, its distance is 1, and it belongs to Antigen Set (Ag). Each performance must be Self or Ag as shown by equations (1) and (2).

$$\text{AP} = \sum \text{ all performances} = \{<\text{name, distance (0, 1), attributes}>\} . \tag{1}$$

$$\text{Self } \cup \text{ Ag = AP;} \quad \text{Self } \cap \text{ Ag} = \phi . \tag{2}$$

Action Engines as antibodies in our autonomous strategies. They are activated by KPIs to eliminate antigens. The population of KPI and AE are changed by the population of detected antigen. KPI is given by the Local Governance component (each participant in collaborative environment has efficient local KPIs), NFP (each KPI governs specific non-functional properties), Age (KPI's lifecycle phase) and AE (each KPI activates relevant action engine). AE is given by the Local Governance component (each participant in collaborative environment has its antibodies), KPI (this antibody is activated by relevant KPI), Age (antibody's lifecycle phase) and Action (antibody's action to eliminate antigens) as shown in equations (3) and (4).

$$\text{KPI} = \{<\text{Local, NFP, Age, AE}> \mid \text{Local} \in \text{ (A, B, C)} \wedge \text{ NFP} \wedge \text{Age} \in \text{KPI} \tag{3}$$
$$\text{(lifecycle)} \wedge \text{ AE} \} .$$

$$\text{AE} = \{<\text{Local, KPI, Age, Action}> \mid \text{Level} \in \text{ (A, B, C)} \wedge \text{ KPI} \wedge \text{Age} \in \text{AE} \quad \text{v}(4)$$
$$\text{(lifecycle)} \wedge \text{ Action} \} .$$

Aggregator Selection Strategies. In order to give comprehensive governance results for collaborative enterprises, aggregators analyze business processes and NFP classification to integrate scattered KPIs and AEs' results, and to aggregate global collaborative results.

$$\text{Aggregator's result} = \sum \text{ relevant KPIs' measure results + relevant AE's} \tag{5}$$
$$\text{results}$$

4   Conclusion

This paper proposes a distributed Governance as a Service framework with immune-inspired strategy. It has self-adaptability and can seamlessly collaborate with various enterprises. It overcomes existing collaborative enterprise governance limits; comprehensively govern collaborative networks' performance and increase the flexibility and intelligence from business processes to infrastructure operations. It optimizes enterprises' ability to quickly and efficiently set-up, maintain, develop, chose best services and collaborate with partners to reinforce external and internal collaborative work of enterprises. It also improves ability of enterprises to cope with changes from both technical and organizational points of view, and makes sure enterprises get benefits from collaboration. This collaborative and immune-inspired Governance as a Service framework that makes collaborative enterprises can remix information from inside and outside the enterprise to solve problems, reduce wastes and enhance agility flexibility and ability of self-optimization quickly.

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