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Abstract—The increasing demand for business agility mandates enterprises to collaborate on many frontlines to stay competitive and achieve high business performance. This has given rise to the issue of Cross Enterprise Collaboration (CEC), which refers to the collaboration of two or more enterprises in achieving common goals. CEC is facing major people, process and technological challenges today. IT setup in today's enterprises makes them walled gardens, for good reasons, however, it is a prohibiter of successful collaboration among companies, their people, processes and sharing data. In this paper, we propose a framework that facilitates the understanding of major CEC challenges. Facilitating CEC require supporting process-level collaboration, and protection of shared IP and data with various enterprise-level and regulatory policies. We present a novel method and system for conversation-oriented, flexible and policy-aware process collaboration among people from different enterprises. We focus on the scenario of the collaboration of providers in multi-sourced IT services. The system is designed to be offered as a service in the cloud.

Keywords- *Multi-sourcing services; cross-enterprise processes; policy-aware data-sharing; collaborative processes*

I. INTRODUCTION

Few organizations control all aspects of their business, their supply chain, sales channels and their business processes. For businesses, collaboration with external entities is becoming a necessity for achieving a higher performance and engaging in bigger and more successful business opportunities. A new trend of service outsourcing is multi-sourcing in which a customer signs a deal with multiple providers each accountable for one or more aspects of the required service. This mandates the service providers to work together to offer a seamless service experience to the customer. This is a prominent case of cross enterprise Collaboration (CEC), which refers to the collaboration of two or more organizations towards achieving a common goal.

In multi-sourcing, the service providers need to collaborate in planning, designing, and delivering the services. In some cases, the overall responsibility of ensuring the whole service is delegated to a third party service provider, called service integrator, that needs to facilitate the collaboration of enterprises and is responsible for the overall service deliverables and experience. However, this does not remove the need for collaboration among providers altogether.

Collaboration across enterprise boundaries brings a set of unique challenges. For instance, in multi-sourcing, some of challenges include the governance, relationship management and collaborative process management among the service providers, the client and service integrator. With the trend towards shorter lifetime of services, the collaborations are becoming more agile and shorter in lifespan. Traditional collaboration approaches that require lengthy and in-advance planning for establishing the collaboration does not scale. As another challenge, providers in a multisourced service deal are potentially competitors, too. This brings us the issue of what and how to share proprietary resources and knowledge in a way that protects the interests of the parties and minimizes the liabilities. For a successful collaboration, the service providers need to coordinate activities and share information on solution design, delivery and operation. There are often best practice processes such as ITIL (IT Infrastructure Library) [1] for IT services, which are often adopted by the service providers or for the design, delivery and operation of services.

While there are frameworks and solutions that support execution and enactment of best practice processes such as ITIL within an enterprise, there is no system supporting a cross enterprise definition and enactment of it. Using ITIL for IT service delivery in a multi-sourcing scenario adds more complexity to it. In addition to multiple partners, there are multiple levels of people engaged in collaboration including deal management, designers, analysts, engineers, technicians and operation people. As we have observed in emprise (IT) environments [3], the definition and enactment of best practice processes is often through conversation among people rather than defining rigorous models in advance and following rigorous execution methods put forward by traditional business process management approaches. On the other hand, tools that support conversations among people are oblivious about the processes that are agreed upon, the protection policies that govern those interactions and the data and commitments that are exchanged during the collaboration.

In this article, we present a framework for cross enterprise collaboration in multi-sourcing IT services. The framework presents a number of conceptual layers, in a stack, that represents main CEC technological requirements at various levels of abstraction. We then describe a technical architecture for a technology solution, called CEC-Flow, which supports the definition and enactment of best practice processes in a cross enterprise collaboration setting.

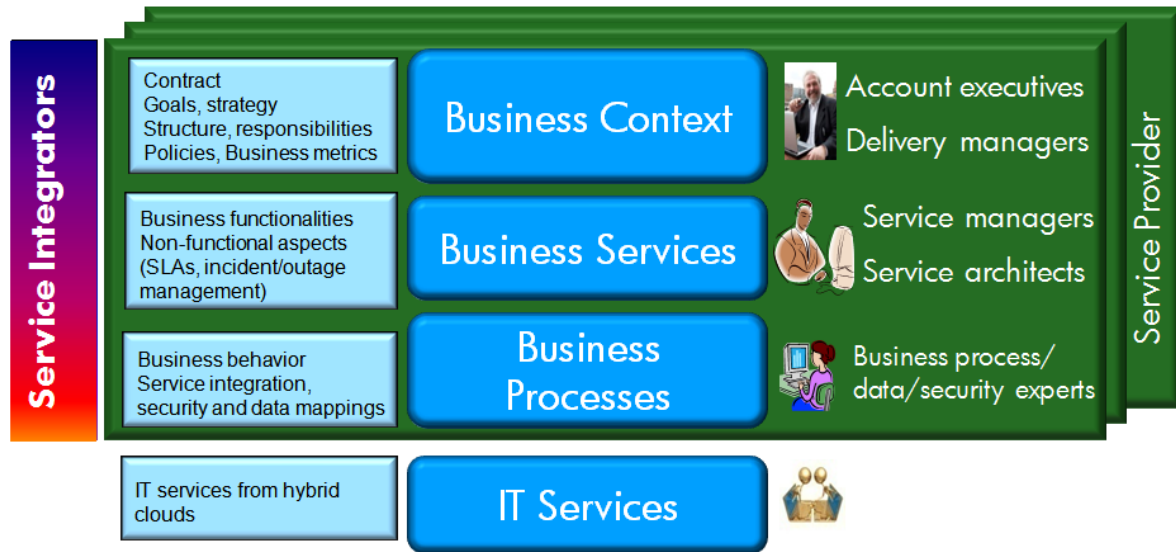


Figure 1. The conceptual framework for understanding CEC issues in multisourcing scenarios

Collaboration among people in CEC-Flow happens through conversation among participants over which processes and policies are supported in a flexible and adaptive manner. CEC-Flow supports the definition of secure and compliance-aware data access and sharing. The solution is architected to be offered as a service in the cloud. We describe a prototype implementation of CEC-Flow system.

The paper is structured as follows. In Section II, we introduce a conceptual framework that facilitates understanding CEC issues or collaboration of providers in multisourced services. Section III presents an architectural framework for a solution, offered as a service, which addresses the challenges identified in Section II. Section IV introduces CEC-Flow, and how it supports best practice processes and policies in an environment for CEC. In Section V, we discuss related work, and conclude and present areas of future work in Section VI.

II. CEC IN MULTI-SOURCING

In single sourcing or what is traditionally referred as outsourcing, a single service provider fulfills the entire outsourcing need of a client enterprise for a given service contract. There is a growing trend towards multi-sourcing in which multiple service providers participate in offering the service to the client. Each provider is responsible for a part of the service in which they specialize. An example is outsourcing for cloud services, in which the client has a hybrid portfolio consisting of in-house and externally acquired services with different vendors. One concern is how to provide a seamless experience for the client in their IT environment. Another is how to facilitate the collaboration of service providers and the client in identifying client's requirements, design and delivery of the solution and during the service operation. In this paper, we focus on the latter.

Figure 1 shows the issues that are subject to collaboration across multiple service providers in a multisourcing scenario, the client, and in some cases the service integrator. Service integrator is a third party entity that client hires to act on behalf of the client and to coordinate the service delivery activities. Having a service integrator simplifies the collaboration among participant, but not removes the need for collaboration among participants and at least the collaboration of provider/integrator/client in the delivery of the service.

The collaboration among the partners needs to be established at several levels of people and abstractions. From the people point of view, the collaboration among account management, architects and designers, software engineers and IT technicians need to be established. Each group of these people needs different requirements. Orthogonally to this, the collaboration among people needs to be supported at different levels of technology stack from simple communication among people to collaborative process enactment.

Most common means of communication among people today are email, instant messaging and voice conversations. There are solutions in this space from companies such as Microsoft and Cisco that support unification of communication among people. Let's assume that they are offered as external IT services for the collaboration. What remains unexplored in this space is supporting effective collaboration on top of communication services. In particular, in a given multisourcing scenario, the interacting partners need effective knowledge sharing and automation assistance in capturing the commitments that are exchanged in the conversations, and providing support for capturing action items, assignment and tracking of them over the course of interactions that may span several group conversations.

In many of these conversations, interacting people usually follow some common best practice processes as a framework to drive the work. For IT services, a commonly used framework for IT service management is ITIL. For collaboration of providers of a multisourced service, some requirements of collaboration, specifically at the process-level, include:

- *Agile*: the trends towards shorter contract cycles for services, there is mandate for shorter customer on-boarding cycles and delivery periods. This entails the need for fast setup of collaboration.
- *Flexible and modular*: the process collaboration framework needs to be flexible. The participants in the conversations and collaboration may be dynamically added or removed, and also the flow of activities among the participants needs to be adaptive so that can be easily changed in response to changes in the working environment and the plans.
- *Interleaved process definition and enactment*: unlike traditional process frameworks and tool, where collaborative process model is defined and agreed-upon first, the process-aware and conversation-based collaborative framework should not require in advance definition of the process, but support an interleaved process definition and enactment.
- *Automated action assistance*: there is a need for automatic and intelligent assistant to extract information related to action item definition, enactment and progress from the conversations among participants.

III. A FRAEMWROK FOR CEC-AS-A-SERVICE

A. Overview

A primary observation in collaborations (among people from different teams or enterprises) is that collaboration is formulated in a number of conversations among different groups of people, each related to one or more best practice processes. Thus, there is a need for connecting conversations to processes, their definitions and enactments. In addition, unlike the conversations that happen among participants of the same enterprise, there is a number of policies that govern the interactions and data that is shared among the participants during the course of collaboration.

Our design of the collaboration framework takes into account these two pillars: conversational nature of process-focused interactions, and the sensitivity of data that are

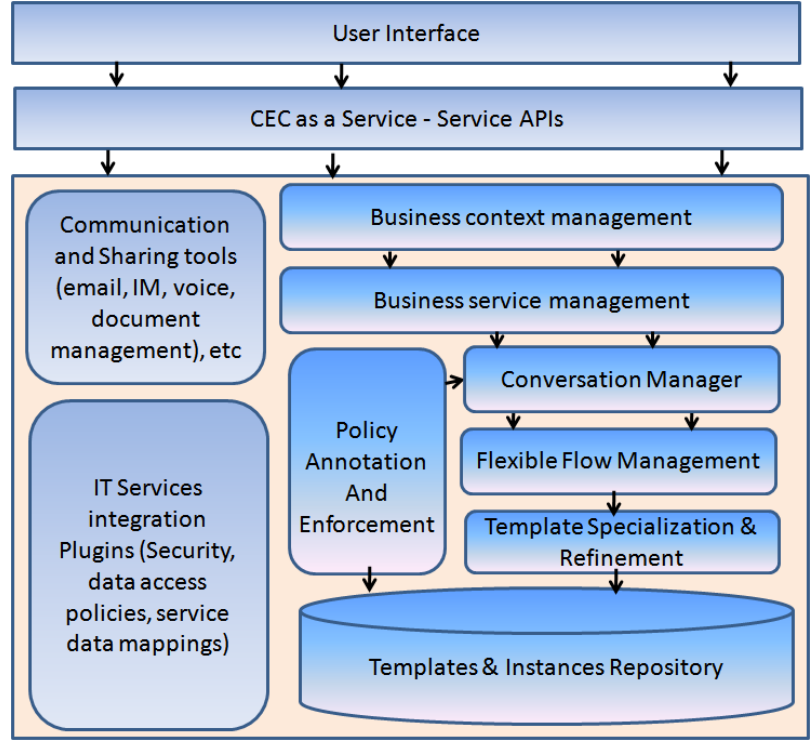


Figure 2. The conceptual framework for offering CEC support as a service in multisourced IT services

exchanged across the border of the enterprises. Conversations are the center of universe in our collaboration approach. It is called process-aware as we support the definition and enactment of processes on top of conversations. The framework also supports annotating data to attach policies (such as security, privacy, etc.) to it. That is the basis for recognizing the framework as policy-aware. Based on our previous work [2], we provide enforcement capabilities for some of these policies. Finally, we envision offering the solution as a cloud service.

B. Architecture

Figure 2 shows the proposed architecture for the framework supporting process-aware conversations in a cross enterprise setting, specifically for collaborations among providers in a multisourced IT services offering. The architecture consists of following categories of components:

- **Business context management**: support for conversations around documents such as contracts, timelines, budgets, etc. The novel aspect is enabling conversations around these objects, referring to parts of them in conversations and relating them to lower level processes and resources.
- **Business service management**: this is a specific component for IT service management environment, where issues from contract and other planning documents are taken into the next level of details and planning for issues such as outage management, SLAs, etc. A novel

aspect, apart from the ability to link to business context and business processes, above and below in the stack, is enabling the conversations about these items by people in different organizations.

- Collaboration templates, their specialization and refinement: The framework offers templates according to best practice processes such as ITIL, and enables collaborating enterprises to specialize and refine them in their conversations for their specific need.
- Conversation manager: it is responsible for providing a holistic experience of users on different components and facilitating the conversations among people around various objects. In particular, this component leverages communication tools and offers automated intelligence to infer information about the business objects and action items and linking them to the other components.
- Flexible flow management: this component is responsible for the definition, enactment and tracking of best practice processes. Its main role is offering flexibility and adaptation of best practice process flow in conversations among people.
- Policy annotation and enforcement: this component supports the definition of different types of policies that applies to data and other business objects. During conversations, this component enables attaching policies to business objects, action items and data that are exchanged. This provides a fine-grained approach for policy attachment as often different set of policies applies to different type of data that are shared and action items.
- Adapter components intend to plug external services into the framework. Examples of those are communication tools, security federation and integration tools and document management tools.

IV. CEC-FLOW: FACILITATING CROSS ENTERPRISE COLLABORATIVE PROCESSES

In this section, we introduce CEC-Flow a language and a system for facilitating cross enterprise and collaborative processes. CEC-Flow realizes the conversation management aspect of the CEC-as-a-Service framework introduced in Section III, flow management, template management and policy attachments to data.

A. Collaborative Process-aware Conversations

CEC-Flow is a framework for collaboration across different teams in an organization, or across different people from different organizations. It offers a system and method for supporting people in flexible, collaborative and adaptive definition and enactment of best practice processes. CEC-Flow bridges the gap between traditional collaborative

business process frameworks and communication tools using which people conversation happens. CEC-Flow advocates the notion of a process-aware conversation that includes:

- The informal thread of interactions between participants (chat, email threads, etc);
- A semi-structured flow of work activities consisting of a set of tasks and their dependencies, defined by the participants of the conversation, and
- Association of the informal interactions and the definition/enactment of flow activities through weaving tasks in conversations.

In order to support process-aware conversations in a cross enterprise setting, we make the following provisions:

- We define “touch points” of the collaborative activity flow that spans across multiple partners with the internal processes of organizations. This is in contrast with traditional approaches that advocate the tight integration of collaborative (also referred as public processes) and private processes of each partner. The touch points are identified by conversation participants in a collaborative manner. This model supports a loosely coupled method for the collaboration among enterprises at the process level.
- We recommend the definition of minimal set of touch points and interfaces among collaborative process and the private processes of each enterprise. This allows for more simplicity and flexibility of how work gets done collaboratively and by each partners.
- We provide a means for the definition of mapping of terminology of the collaborative flow, and those of each partner for each touch point.
- Finally, we enable weaving touch points into the collaborative flow structure that backs the informal thread of a conversation.

Above considerations lead us to the following definition of the CEC-Flow language that backs process-aware conversations:

A CEC flow model is a graph that contains the tasks that are collaboratively defined and the relationships among the tasks (the dependencies among them). Each task is defined by three set of elements: task properties (name, descriptions, etc), roles that are engaged in the tasks, and the touch points. We adopt the RACI (Responsible, Accountable, Consulted, Informed) framework for definition of task roles, which specify the involvement of conversation participants in the task. Each task can have one or more touch points defined, each referring to a participating enterprise. It provides information on the expected input/output from/to partner. When more than one touch points are defined for a task, it is assumed performing the task requires collaboration among those enterprises, and therefore, there is a need to break down the task to sub-tasks that each has only one touch point, and the dependency relationships among the

enterprises are defined. Finally, CEC-Flow enables associating the text in any conversations (in different part of the same conversation or across several different related conversation) to a task to provide the context and information on the progress of the task across multiple conversations during the course of collaborations (task status changes also reflected with the text association to monitor progress). In other words, the flow model is defined for the collaboration, and multiple set of conversations instances may be associated to the global, collaborative flow model. To facilitate the conversations among people in a multisourced IT service, we extend our prior work on IT Conversation Manager [3].

B. Data Assurance policy for collaborative processes

In collaboration among multiple enterprises, the protection of data and regulatory compliance are among the concerns. This comes from the fact that there are potentially proprietary and confidential data and customer information from different firms. Traditionally, these issues are negotiated and handled in an upfront contractual agreement before the collaboration is started. However, different policies apply to different piece of data, and one-size fits all of upfront agreement may not make it clear what applies to what. The policy requirements are often customer- and engagement-specific. We enable annotating the data that are exchanged in a collaboration based on a policy (based on our previous work GEODAC [2]) that enables fine-grained policy specification and annotation.

The system allows policies to be attached to tasks and to data types. The current set of policies that are supported by the language include security, privacy, ownership, data retention, data confidentiality, and appropriateness of usage. The system allows defining generic policies and parameterizing them on attaching to data that are exchanged or tasks defined in a conversation. Some of these policies such as security are enforced based on existing technologies. For example, security policies are applied to control access to data. The other types of policies that are attached to data act as guidelines for people accessing or using the data on what is permitted. Policies that are attached to task specify that all the data that are input/output of the tasks is subject to those policies.

We have implemented a prototype system for CEC-FLOW, by extending our work on IT Conversation Manager [3] that supports cross-enterprise definition and enactment of best practice processes, and the association of policies to data and tasks in collaborative conversations around best practice processes.

V. RELATED WORK

The definition and implementation of cross organizational processes has been studied in various domains including supply chains [4], Web services and also in workflow and business process management spaces. We review related work in the following.

In the supply chain domain, the most common form of cross enterprise process-level collaboration has been

achieved through deep integration of systems that implement processes. In particular, the implementation of standards such as EDI [5] and RosettaNet [6], and the development of vertical solutions by solution providers such as SAP are representative of works in this space.

In the literature, there are a number of work in the inter-organizational workflows space. In particular, [8] suggests a level-wise approach for enterprise process integration approach where it starts from developing a process integration strategy, which is refined into business process engineering level and mapping to IT systems in the respective enterprises, subsequently. Another approach is P2P (public to private) process integration approach [9], where a public process model is first devised by the collaborators, and then private views are extracted from the public model and mapped to internal business processes. Another related work in this space is CrossFlow [10], which provides a framework for cross-organization workflow management. This approach starts from the specification of contracts and provides a method for refining it down to executable business processes for each enterprise. As a related and follow-on work of authors, CrossWork [11] integrates CrossFlow an P2P to first devise a public process model that is then refined into private views for each enterprise. In contrast to above work, where a (public) workflow model is developed for collaboration, cooperation policies [12] describe a set of interaction scenarios among the enterprises rather than one workflow. Finally, in the Web services space, standards such as WSCL (Web Service Choreography Description Language) [13] is the representative of a standardization effort for developing specification for public and private views of a collaborative process for a set of entities that need to collaborate.

What all these work have in common is advocating the definition of an in-advance formal process model for collaboration among the enterprises, and then mapping it to internal processes of each enterprise. However, our observation is many real world service engagements shows that collaborations among participants are not often defined in advance, but are defined and enacted in an interleaved and “as-you-go” fashion. In addition, the main method of conducting these activities is through conversations among participants from different enterprises. CEC-Flow framework supports conversation-oriented, flexible and ad-hoc definition and enactment of collaborative processes among enterprises.

VI. CONCLUSION AND FUTURE WORK

This paper presents a framework for enabling cross enterprise collaboration, offered as a service to collaborating enterprises. It introduces CEC-Flow, which is a novel language and accompanying system that supports conversation-oriented process collaboration among participants from different enterprises. Recognizing the importance of the policies that govern the interactions among participants from different enterprises, the system also provides a policy definition framework to annotate and partially enforce policies attached to data and tasks.

In terms of future work, we are extending our conversation-oriented process collaboration approach with intelligent assistance. We also plan to extend our policy language framework to enable enforcement of more categories of policies for the data that are kept within our service environment. Finally, we plan to support the business context and business services layers in our implementation to realize the vision of offering CEC as a service.

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