SocEDA

Cloud based platform for large scale social aware EDA

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Table of Contents

1. Workflow Flexibility/Adaptation definitions.

The notion of flexibility has emerged with the evolution of industrial relationships, evolution characterized as "the transformation of a crystalline structure in a fluid environment" (Benaben et al., 2007) or as "the transformation of a static building in a living organism "(Luzeau et al., 2008). These metaphors reflect the evolution of collaborations between companies. They are no longer based on a long-term collaboration with are difficult to establish. Today, they are based on opportunistic collaboration, rapidly established and dissolved.

Lots of definitions concerning flexibility converge at a company can be called flexible if it can adapt to the variation of the context in which it operates. Some authors, such as (Badot, 1998), talk about reconfiguration of system. Other authors, such as (Kidd, 1994) (Lindberg, 1990) and (Sharifi et al., 1999) talk about a need of flexibility, responsiveness or adaptability. In the field of logistics, flexibility is seen as "the ability to meet short-term changes" (Sheffi, 2004), it is differentiated to adapt over time in response to a change (Mc Cullen et al., 2006).

Following these considerations, we will retain flexibility as its three components: responsiveness, adaptation and detection (the first component related to the speed of adaptation, the second to the magnitude of this adaptation and the third at the time of adaptation). If we report three goals in information systems and more specifically wokflows, we realize that flexibility cannot usually involve a change in the material part of information systems (as defined in (Morley et al., 2005)). Indeed a modification of the technical implementation of information system can mean obvious problems of delay. Thus, whether in relation to the responsiveness or adaptation, only the information part of information system (as defined in (Morley et al., 2005)) can be changed. This part of information system based especially on the characteristics of the situation and the skills of different organizations and actors, which must be described by business processes. these processes characterize the sequence of the collaboration. These processes are then used as the basis for the realization of the information system.

In (WfMC, 1995), workflows are distinguished into three types: the build-time functions, control functions of the run-time and run-time interaction with users and applications. (Nurcan, 2005) differs from these types, two kinds of flexibility in function of the ability to incorporate changes due to changes in the build-time or run-time. This distinction is also proposed in (Schonenberg et al., 2008).

From these considerations, Figure 1 presents an overview of a process of realization of an information system. The white part represents the collaborative information system based on the characteristics of the collaboration and the abilities of the actors, which is used to define the collaborative processes. Then, these processes will be transformed into wokflows to be executed during run-time. The black part represents the different elements of flexibility including the detection of evolutions (that can be automatic or manual) and adaptation approaches. These approaches can be implemented either at design time or during run-time

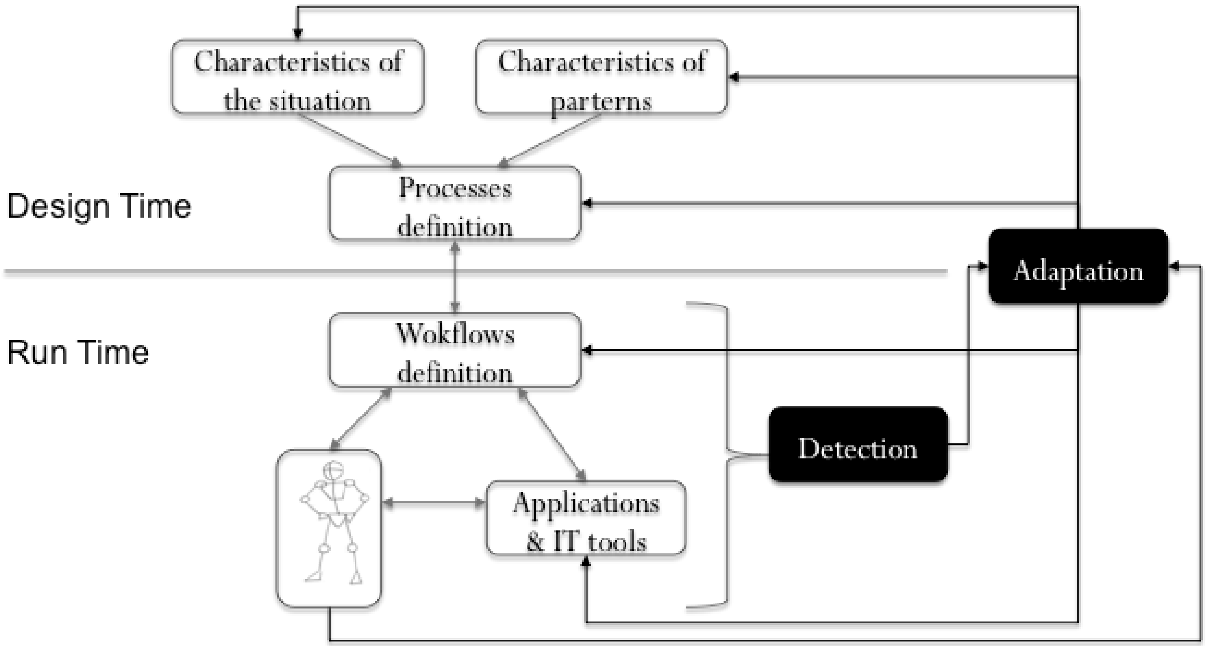

Figure 1: overview of flexibility approaches

Before presenting the various types of adaptation approaches, we will return to the advantage of an SOA in front of the distinction between design-time and run-time.

2. Flexibility approaches in SOA context.

A service-oriented architecture (SOA) is architecture of information system where the connection between design-time and run-time is more intuitive than any other type of information system architecture. In this section we will therefore be interested in the concept of SOA.

2.1. SOA characteristics for flexibility

Service Oriented Architecture (SOA) is the term used for a "kind of architecture from common organized business services to a shared set of business lines or applications" (Raymond, 2007). All of these software applications are commonly called "services". These services are then executed in a predetermined order when an event occurs. These basic elements identified by the SOA (Vernadat, 2006), under the term "event", "services" and "process" must be understood and compared to "trade" and "application". This correspondence between the level of "trade" (in our case, the description of a collaboration between organizations), and level "application" (in our case, the information system), which is interesting in order to link the design-time and run-time. This vision of SOA shows the strong link between information systems and business processes of a company that has adopted this kind of architecture. In this case, a business process can be executed thanks to a projection of these processes thanks to the correspondence between services of information system and a set of "business" services. To ease the reading, later in this chapter we mean by "service", an application service of information system.

SOA can be seen as, or at least contribute to develop a flexible architecture for information systems. In fact, SOA cuts an information system in smaller structuring services and potentially easier to change (Raymond, 2007). Moreover, according to (Monfort et al., 2004), this cutting facilitates exchanges between actors. Consequently, SOA is a response adapted to the conceptual link between design-time and run-time, first by the flexibility and accessibility it provides to the information system, and secondly the projection to the business processes defined at design-time on information systems.

2.2. ESB for flexibility

We have just explained that SOA enabled us to link the business services (design-time) and the services of an information system (run-time). This correspondence is the key point that allows us to match a process defined in "business" with a process of "technical" (workflow). Unfortunately, SOA is not enough to provide flexibility. The architecture must be able to (i) control a process that can evolve over time, (ii) manage the data, (iii) manage the application. To bring flexibility, it is necessary:

- To connect dynamically to services from different systems.
- To be able to transform information.

- To be able to run a process.

We decided to use as technologic support, which proposes these capabilities, an Enterprise Service Bus (ESB). An ESB, as the name suggests, focuses on the concept of bus. The distribution of services is the main advantage of such infrastructure (HBS, 2005). ESB provides an indirect link between different part of information systems: When a service is connected to a bus, it is connected with all the potential services already connected, even if these services come from different technologies. However, the fact that the services of information systems can be realized from different technologies can lead to a connectivity problem. To solve this problem, ESB proposes a set of connectors based on the standard J2CA (J2EE Connector Architecture) (EBM, 2005) that allows connections to services largely heterogeneous. Finally, as shown in Figure 2, ESB avoids the creation of peer-to-peer connection between the services, and allows a fast and dynamic connection between services.

Finally an ESB must provide technical services such as message transformation, routing based on content and the orchestration of services (HBS, 2005). In (ISyCri, 2008), the orchestration is defined as "an expression of the conditions and sequences of invocations to services. As part of the service-oriented architectures (SOA), the orchestrations are seen as compositions of services defining new services. Defines a workflow orchestration between the services. As part of ISyCri, this workflow must be observable and controllable." ESB should be able to run a collaborative process defined in a language that the orchestration engine understood.

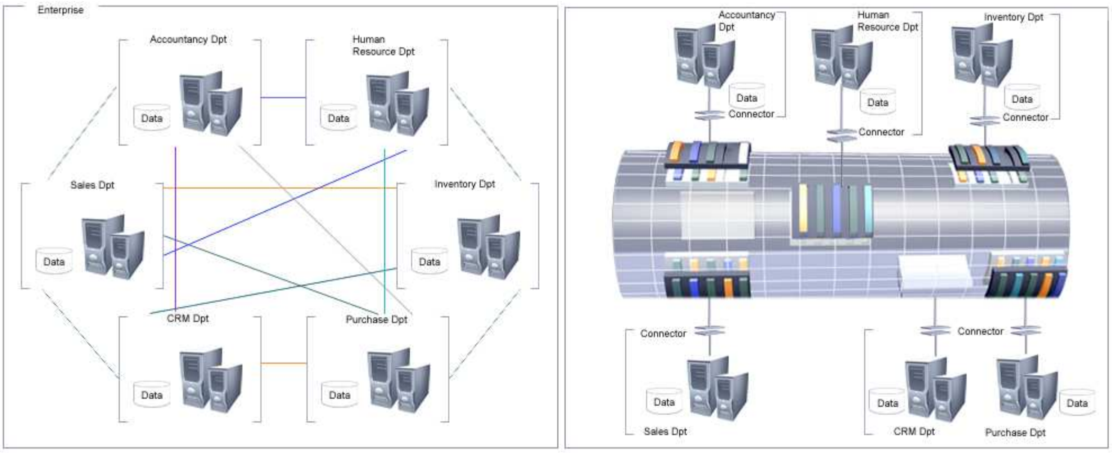

Figure 2: peer-to-peer connection between services VS connection thanks to ESB (EBM, 2005)

3. Workflow Adaptation approaches.

This part of the study is based primarily work on the management of uncertainty in workflow systems. We mention in particular the adaptative inter-organizational workflow (Andonoff et al., 2007) or the approach ADEPTflex (Reichert et al., 1998) or work in the same vein (van der Aalst, 1998). (Schonenberg et al., 2008) have recently proposed a synthesis of this work with a taxonomy of workflow adaptation approaches. This taxonomy, shown schematically in Figure 2, identifies four main classes of approaches. It is noted that the proposed taxonomy of flexibility approaches proposed by the authors are the following:

- Flexibility by design: This is to provide flexibility in the design process including alternative execution paths. Selecting the most appropriate way will be performed at run time. For example, the approach proposed by (Rueppel et al., 2007) is to define a number of possible response processes to a crisis like flood in Germany.
- Flexibility by deviation: This is to provide flexibility at the run-time can change the execution order of activities without changing them (ie allow to cancel, or restart skip a task). For example, The Flow system (van der Aalst et al., 2005) can use this type of flexibility.
- Flexibility by underspecification: This is partly to define the process in terms of design and complete at the run-time. This flexibility is based on tasks or sub-abstract processes can not be defined precisely, but can be identified (ie there are a number of tasks or sub-processes but it is only available when the choice has be done). This type of flexibility is implemented in the YAWL system (van der Aalst et al., 2004). This approach to adaptation is divided into two general approaches just.
  - Late Binding: The elements of workflows are considered as objects whose implementation is defined at run-time process (Chui et al. 1999), (Fautsmann, 1998) (Halliday et al., 2001) (Joeris et al., 1999) (Klingemann, 2000) (Mangan et al., 2003) (Rolland et al., 1999).
  - Late Modelling: some elements of the workflows are not identified at the time of Buid-defined time and at run-time (Agostini et al, 200), (Dellen et al, 1997) (Fautsmann, 1998) (Rolland et al., 1999)
- Flexibility by change: to change the definition of processes running, by the way of the insertion or deletion of tasks. This type of approach is the most common including the ADEPTflex (Reichert and Dadam, 1998) (Borghoff et al, 1997), (Casati et al., 1996) (Dadam et al., 2003) (Herbst, 1999) (Klein et al., 2000) (Kradolfer, 1999) (Meng et al., 2003) (Reichert et al., 1999) (Sadiq, 2000) (van der Aalst, 2001), (van der Aalst, 1999) (Vossen et al., 1999) (Weske, 2001).

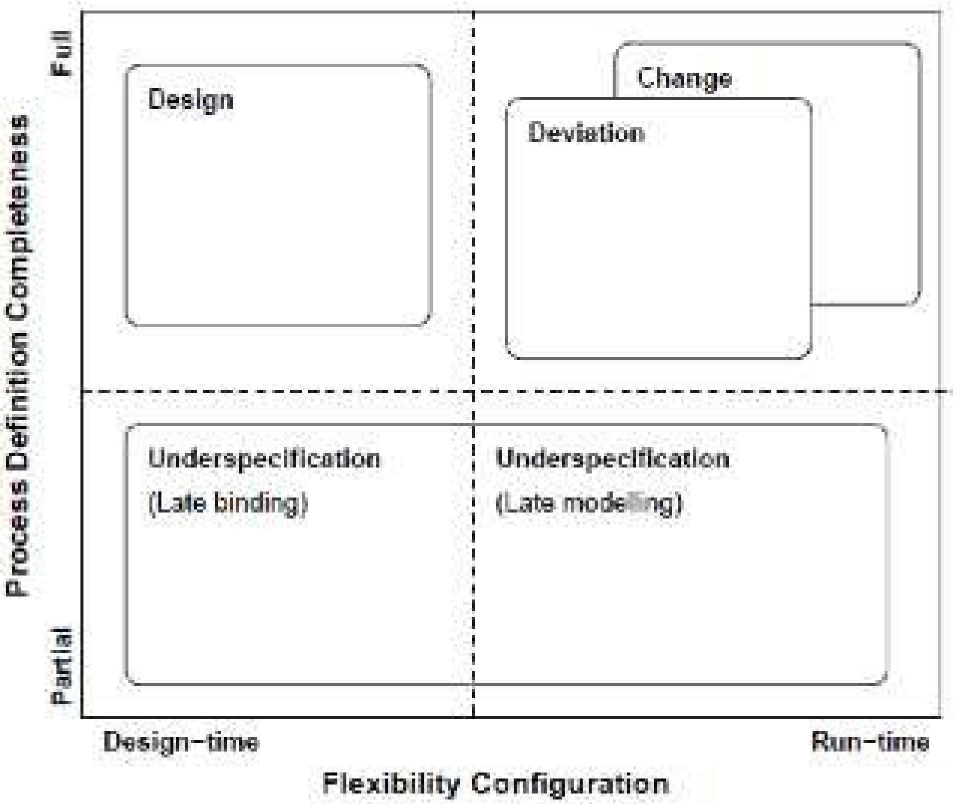

Figure 2: Several kind of flexibility approaches according to (Schonenberg *et al*., 2008).

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