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Event-driven agility of interoperability during the Run-time of collaborative processes

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ABSTRACT

The modern business environment tends to involve a large network of heterogeneous people, devices and organizations that engage in collaborative processes among themselves. Given the nature of this type of collaboration and the high degree of interoperability between partner Information Systems, these processes need to be agile in order to respond to changes in context, which may occur at any time during the collaborative situation.
The objective is to build a Mediation Information System (MIS), in support of collaborative situations, whose architecture must be (i) built to be relevant to the collaborative situation under consideration, (ii) more easily integrated into the existing systems, and (iii) sufficiently agile, through its awareness of the environment and of process events, and through the way it reacts to events detected as being relevant.
To apply agility mechanisms, it is crucial to detect the significant events that will lead to a subsequent evolution of the situation (detection step). Event-Driven Architecture (EDA) is used to design the structure of the part of the system that is in charge of MIS agility. This architecture takes the events into account, manages them and, if needed, uses them to trigger the adaptation of the MIS.
We have defined a means to monitor the evolution of the situation. If relevant changes are detected, and if the situation does not evolve in the expected way, an adaptation is proposed.
It is concluded that the principles of detection and adaptation, combined with the responsiveness of the system (provided by the automation of transitions), and based on Event Driven Architecture principles, together provide the agility required for collaborative processes.

1. Introduction

Nowadays, organizations (such as enterprises, institutions or administrations), the people who work in them and the devices they use, all have to work together and take part in collaboration to be able to operate in an unstable environment. This need for interconnection, and more precisely for collaboration, is revealed by contexts as numerous and various as social networking, domotics, business partnerships, subcontracting, or crisis situations. Our environment is thus tending to become a large network of people, machines and organizations (i.e. the collaborative partners), all involved in collaborative processes among themselves. But taking part in a collaborative process is not necessarily easy for the partners, especially in a context of ephemeral collaboration. Moreover, industrial relationships have evolved and they are no longer based on long-term collaboration. Today they are also based on opportunistic collaboration, rapidly established and dissolved. In this context, the notion of agility has emerged with the understanding that collaboration needs to be flexible.

The ability to collaborate with clients, providers or even competitors has always been a critical requirement in our modern multi-organizations-based ecosystem [13]. However, if collaborating used to concern closely-related organizations (from a geographical point of view), and required time to define a stable and durable relationship, this is no longer the case: nowadays, organizations need to establish their – potentially short-lived – collaborations with partners from all around the world, in a very reactive way in order to seize very fleeting business opportunities. It can be argued that the business ecosystem has evolved from a strongly crystallized structure into a very fluid environment. In this free-flowing context, collaborating is more a way to seize opportunities and to stay dynamically on the top of the wave, rather than a structuring element defining the intensity of the organizations' integration in their geographical and business environment.

Furthermore, Information Systems (ISs) can be considered, on one hand, as the functional backbone of organizations [41] (insofar as they assume the management of their information, functions and behavior) and on the other hand, as the main interface (the visible part of the organization as described by Morley [33]) with any potential partner. Consequently, the management of organizational collaboration should definitely aim to achieve information system interoperability. Our starting point is to approach the collaboration issue through IS interoperability, thus satisfying the business requirements of the organizations.

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In this article, we propose an approach and a set of theoretical results to support collaboration (i.e. the collaborative processes) and enhance its agility. Regarding the specific research works presented in this article, the overall contribution is the following: [5] did define the precise context and requirements of this agility feature while the current article is in charge of providing the reader with all the theoretical studies and results to meet these requirements. Consequently, the contribution of this article mainly concerns the theoretical definition of an agile framework for a Mediation Information System (MIS) (that has been described in previous works).

The remainder of this article is organized as follows: Section 2 gives an overview of the literature on related products and research projects. This section also presents some considerations regarding agility. Section 3 presents and describes our proposal of a platform to support collaboration and to ensure the agility of the processes. Section 4 contains a discussion about the findings, suggestions for further work, and a conclusion.

2. Background

We first provide a brief background to collaboration support tools and flexibility (agility) principles, presenting several commercial and research works on workflow agility. Then, some core ideas of Event-Driven Architecture (EDA) are presented, to justify the need for such architecture and the use of a Complex Event Processing (CEP) engine in the platform.

2.1. Tools to support collaboration and its agility

For a decade, several commercial products and research projects have been attempting to design, orchestrate and provide agility to collaborative workflows. On the commercial side, the major actors are Bonita and the tools that are based on Architecture of Integrated Information Systems (ARIS) [47]. Bonita Open Solution (developed by Bonitasoft [8]) offers a suite of tools to design, execute and monitor processes. ARIS tools aim to model enterprises. Generally, there are platforms providing functions to model the business processes and to implement them as workflows, to execute and monitor them. The ARIS approach can also integrate the notion of events inside the process modeling. An interesting point here is ARIS' ability to combine determined process fragments according to received events. In a way, the ARIS approach manages workflow adaptation (but in a determinist manner).

We can cite the WORKPAD project [11], which designed and developed a software infrastructure to support collaboration in emergency/disaster scenarios. This project aimed to create communities of Public Safety Systems (PSSs) and to enable mobile teams to exploit PSSs through mobile technologies, process management and geo-collaboration. On the adaptation side, they focused on recovering the disconnecting nodes through specific tasks. The CRISIS [54] project aimed at developing a train-on-demand simulation platform to train first responders and crisis managers: their platform helps to explore decision-making under conditions of uncertainty. They do not really orchestrate workflows: they focus more on the decision-making part when facing new risks, or new uncertainties.

Other platforms propose event subscription and publication. For example, we can cite the Pachube project [21], which offers a platform to subscribe to and publish events. But Pachube does not offer any computation on them. The PRONTO project [30] aims at collecting and deducing complex events from event streams, but it does not focus on the workflow management part.

The European project PLAY proposes a modeling framework named SANs (Situation Action Networks [51]. SANs are goal-directed tree models that allow to find alternative activities to reach the goals defined by the collaborative processes. The moment of the choice to adapt or not the processes is based on determined milestones.

The following table presents these existing results regarding *agility* of collaborative workflows and mainly according to three main components of agility (to be defined more precisely in next Section 2.2): *detection* of a need of adaptation, *adaptation* of workflows and *responsiveness* of the whole. The first feature (*detection*) concerns the ability of the product/project to diagnose that the currently running behavior is no longer in line with the situation (for any known or unknown reason). The second feature (*adaptation*) concerns the ability of the product/project to define (on the fly) a new and relevant behavior (i.e. collaborative workflows) according to the knowledge provided by the *detection* feature. Finally the third feature (*responsiveness*) concerns the ability of the product/project to perform *detection* and *adaptation* in a fast and reactive way (in order not to get a "slow motion reconfiguration", which would definitely not ensure real-time agility).

Table 1 shows us that, for the moment, there are no commercial products or research projects that propose a platform encompassing all the functions of collaborative process design, which can run them, make them context-aware and then adapt them in a short time.

2.2. Concepts of agility

The notion of agility has been widely discussed. As an introduction, the Collins dictionary defines agility as the power of moving quickly and easily. For Badot [4], agility is a reconfiguration of the system to satisfy a need for adaptation. For other authors, such as Kidd [23], Lindberg [25] and Sharifi [49], agility is a need for flexibility, responsiveness or adaptability. In logistics, flexibility is seen as "the ability to meet short-term changes" [50] and is differentiated from adaptation over time in response to a change [31].

Considering the notions of responsiveness (related to the speed of adaptation), adaptation (related to the magnitude of this adaptation) and detection (related to the moment of adaptation), we propose the following definition of agility: *agility is the ability of a subject to lead as quickly as possible, on the one hand, to the detection of its mismatch to a given context, on the other hand, to the setting up of the required adaptation*. In our context, this means that we need to detect when a workflow is not relevant with regard to the collaborative goals and the current context of the collaborative situation (detection), and what needs to be done to deal with this issue (adaptation), as fast as possible (responsiveness).

Table 1
Overview of existing solutions to provide agility to collaborative workflows.

Product/project	Detection of a need for adaptation	Adaptation of workflows	Responsiveness
Bonita	No	No	No
ARIS	Yes (automated, event-driven)	Yes (automated and pre-determined alternatives)	N/A
TIBCO	Yes (manually done)	Yes (manually done)	No
WORKPAD	Yes	No	Yes
CRISIS	Yes	Yes (partial adaptation)	Yes
PRONTO	N/A	No	Yes
PACHUBE	Yes	No	No
PLAY	Yes (pre-determined milestones)	Yes (pre-determined alternatives)	Yes