# ERCIM "Alain Bensoussan" Fellowship Scientific Report

Fellow: Kyriakos Kritikos
Visited Location : FNR – CRP Henri Tudor, Luxembourg
Duration of Visit: 9 months

## I - Scientific activity

During his visit at CRP Henri Tudor, Kyriakos Kritikos collaborated with the members of the Service Science and Innovation Department, especially with Dr. Kubicki, and conducted research focusing mainly on the business service (BS) description, discovery, and composition. To this end, Dr. Kritikos explored the area of business processes and services through the studying of research papers under the guidance of Dr. Kubicki and the participation in informative discussions with researchers involved in the Dest2Co research project (funded by Fonds National de la Recherche). Based on this research, three main research approaches were proposed, where the first will be submitted to a prestigious journal and the other two to high-quality service-related conferences, which were semi-validated by case-studies concerning previous research work in CRP. The first approach proposes a method able to produce the best way a business service can be composed from existing business and software services, which is realized in two sequential steps. The first step is able to propose all unique ways a BS can be composed from other BSs and select the best one according to various criteria, such as cost, non-functional, structural, goal-oriented, and semantic similarity ones. The second step is executed when there is missing BS component functionality in terms of required goals that are unfulfilled or partially achieved. This step first discovers all unique ways the missing BS component's functionality can be realized through software services and then proposes the best one according to various criteria such as cost, non-functional, semantic similarity, and information loss.

The second approach relies on a goal model describing the required BS functional goals, annotated with control flow information, as well as an OWL-Q description of the non-functional BS goals. This approach can propose the best and semantically robust BS composition alternative that fulfills the required BS functional and non-functional goals. Its novelty is that it proposes BS compositions even when a missing functionality exists in terms of unfulfilled or partially achieved goals and considers novel selection criteria such as the composition's number of BSs and the percentage of BSs re-used.

The third approach proposes a broker-based BS negotiation framework able to automatically determine the non-functional requirements of the BS to be designed. This framework obtains a functional goal model as well as the stakeholder requirements, expressed through utility functions concerning the non-functional performance of both the required BS functional goal and its sub-goals, and is able to propose an overall solution that is balanced and consistent across the goal model levels and satisfies as much as possible all the stakeholders.

Apart from this research work, Dr. Kritikos was involved in the Dest2Co project, where he participated in the meetings and the reviewing of the project deliverables and worked on extending his work in semantic QoS-based service description towards expressing non-functional BS attributes and corresponding specifications. The extended work will be integrated into the project to enable the non-functional description of business and software services. Moreover, Dr. Kubicki and Dr. Kritikos plan to extend and integrate Dr. Kritikos work on BS composition and selection into the project's overall BS design methodology. Finally, their cooperation will be continued through the preparation and submission of common research proposals for the 7th European Research Programme.

## II- Publication(s) during your fellowship

*Please insert the title(s), author(s) and abstract(s) of the published paper(s). You may also mention the paper(s) which were prepared during your fellowship period and are under reviewing.*

**Title**: Towards Goal-Oriented Business Service Design and Realization

**Authors**: Kyriakos Kritikos, Sylvain Kubicki, Eric Dubois, Marija Bjekovic

**Abstract**: Due to technology advancements, advanced market competition, and changes on customers' needs and behavior, organizations can only be economically sustainable by adopting and optimizing their business processes and cooperating with other organizations through outsourcing complementary and supporting functionality to their core business. To this end, they adopt service-orientation as the underlying mechanism that can support business process optimization and evolution. Business processes are now seen as business services (BSs) that span organization boundaries and may need to satisfy cross-organizational objectives and transactional properties. To this end, various research approaches have been proposed for designing BS. However, the major drawback of such approaches is that they that they are not able to re-use existing business and software services in order to realize the required BS functionality. Moreover, non-functional requirements and their impact on the BS design are not considered. This research gap is covered by a particular goal-oriented method that is proposed in this paper, which is able to discover those business and software service compositions that fulfil the functional and non-functional requirements of the BS to be designed. In particular, the method consists of two main steps, where the first step is able to produce the best way a BS can be produced from other BSs while the second step is able to produce the best way the missing BS components' functionality can be realized in terms of software services. The proposed method advances the state-of-the-art in service composition by being able to both select the best composition plan and the best services realizing the functionality of the plan's tasks according to various plan and service selection criteria.

**Title**: A Goal-Based Business Service Selection Approach

**Authors**: Kyriakos Kritikos, Sylvain Kubicki, Eric Dubois

**Abstract**: As business process optimization and innovation are the only means for organizations to survive in such a dynamic business world, they are now combining BPM technologies with service-orientation so as to achieve these goals. Business processes are now considered as business services (BSs) that span the organizational boundaries and have to satisfy cross-organizational objectives. The most promising research approaches on BS design are not only considering what the BS does and how but also the business requirements that it must satisfy. They are also able to perform BS composition. However, they mainly concentrate on the functional aspect and not on the non-functional one. Even if very few of them do consider the non-functional aspect, they are not able to select the best BS combination alternative in a precise and objective way. To this end, this paper proposes a goal-oriented approach that is able to discover the best possible way a BS can be composed from other BSs according to both functional and non-functional requirements. This approach advances the state-of-the-art in service composition and selection as it is able to propose semantically robust BS combinations even if there is a missing functionality in terms of partially fulfilled or unfulfilled required goals and considers novel optimization criteria such as the number of BSs constituting the proposed solution and the percentage of BSs reused.

**Title**: An Automatic Requirements Negotiation Approach for Business Services

**Authors**: Kyriakos Kritikos, Sylvain Kubicki, Eric Dubois, Sophie Ramel

**Abstract**: Organizations now resort to service-orientation as it enables them to quickly create and offer new business services (BSs) or optimize the existing ones. In many cases, organizations have to cooperate to offer such services so as to be able to concentrate only on their core business. During the design of a novel BS, an initial phase pertains to the determination of the BS's functional and non-functional requirements. The respective research approaches exploit goal model to specify and elicit such requirements. However, while it is easy to reach an agreement for the functional requirements, this is not true for the non-functional ones. First, as the involved stakeholders may have different requirements and different level of expertise for particular non-functional aspects. Second, as a BS's non-functional performance is critical for distinguishing among functionally-equivalent BSs of other competing organizations. Thus, the BS stakeholders must negotiate over the non-functional requirements of the BS to be designed. However, such a negotiation may take considerable time and needs the active stakeholder involvement in terms of alternative offers for the conflicting requirements. To this end, this paper proposes a broker-based BS negotiation framework that is able to automatically determine the non-functional requirement of the required BS. This framework takes as input a functional goal model as well as the stakeholder requirements in terms of utility functions on the non-functional performance of the required BS functional goal and its sub-goals, and is able to propose an overall solutions that is balanced and consistent across the goal model levels and satisfies as much as possible all the stakeholders.

## III -Attended Seminars, Workshops, and Conferences

*Please identify the name(s), date(s) and place(s) of the events in which you participated during your fellowship period.*

The fellow performed the following two seminars:
1. Previous research work and proposals for its integration into the Dest2Co project, 22/07/2010, CRP Henri Tudor - Luxembourg
2. Business Service Matching, 3/12/2010, Politecnico di Milano - Italy

## IV – Research Exchange Programme (12 month scheme)

*Please identify the name(s), date(s) and place(s) of your Research Exchanges during your fellowship period and detail them .*