

Business process implementation through SaaS services composition

Mouna Rekik¹, Manel Fourati¹ and Khouloud Boukadi¹

¹University of Sfax, MIRACL Research Laboratory, Tunisia

Abstract

The Business process achievement requires various and heterogeneous knowledge i.e. computer information, business and information technology. Enterprises relying on Business processes to gain an added value should have a sufficient expertise necessary to maintain their competitiveness in the marketplace. The cloud computing and more specifically the Software as a Service (SaaS) composition, is a prominent solution allowing the well achievement of Business Processes (BPs) goals and objectives. However, composing multiple SaaS services to support the BP execution is not a trivial task regarding the complex nature of the BP. Indeed, BP is composed of a set of inter-related activities having each one a specific functional requirements, data that should be exchanged between each SaaS service, and roles imposing that only authorized actors can perform a specific activity.

This paper proposes a comprehensive framework for SaaS selection and composition in order to cover various considerations related to matching BP activities requirements and SaaS functionalities. The allocation of BP activities to be executed SaaS services using a genetic algorithm while considering the data and the activities access control issues.

Keywords

Business Process, SaaS composition, Genetic algorithm,

1. Introduction

Achieving " the enterprise business goals and their strategic objectives is becoming easier regarding the maturity of the available Business Process Management Systems (BPMS). However, deciding to cut off with traditional Information Technology (IT) systems to adopt BPMS ones is not a trivial neither a well-worn practice. The reconstitution of the enterprise IT to adopt business process based systems requires good business and IT expertise.

Taking advantage of the maturity of emergent and available technologies, such as cloud computing services, is a less expensive solution, as it reduces the burden of installing and configuring BPMS. Integrating cloud computing in enterprise IT assets is exhibiting exponential interest. Indeed, cloud computing is seen as a potential means to increase enterprises' business agility, reduce software and hardware expenditure, and enhance productivity.

Regarding the plethora and the proliferation of the Software as a Service (SaaS) in the cloud environment, finding the most appropriate service, to support the achievement of the enterprise functional and non functional requirements, is becoming a fastidious task. For enterprises


Tunisian Algerian Conference on Applied Computing (TACC 2021), December 18–20, 2021, Tabarka, Tunisia

✉ mouna.rekik@istls.u-sousse.rnu.tn (M. Rekik); manel.fourati@fsegs.rnu.tn (M. Fourati);

khouloud.boukadi@fsegs.usf.tn (K. Boukadi)



© 2021 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

 CEUR Workshop Proceedings (CEUR-WS.org)

relying on business process to gain added value, considering several SaaS services cooperating to achieve the added value, requires tackling several issues. Firstly, each SaaS offers different business functions which may fit or not each Business Process (BP) activity functionality. Moreover, there is no standard SaaS services description that unifies the heterogeneity when labeling the SaaS offerings. Furthermore, the business process structure, makes harder the BP outsourcing to SaaS. Indeed, BP is composed among others, of flow and connecting objects, swimlane and artifacts. Adopting BP based SaaS composition should keep as most as possible the BP main components.

This paper proposes a comprehensive system for BP based SaaS composition that tackles the overall mentioned issues :

- The semantic matching between each BP activity and its data object with the SaaS offering and its input/output data. Indeed, a BP activity/data label and the SaaS service/data may use different semantic description although they are functionally equivalent.
- The consideration of the data exchanged between the on-premise BP activities and the outsourced to SaaS ones. Indeed, the access to data managed by SaaS offers is not always possible. Furthermore, importing and exporting data to and from SaaS services may be not allowed for some SaaS providers. Hence, accessing to data handled by SaaS providers is very critical in the BP based SaaS composition as different SaaS services are supposed to cooperate together and/or with on-premise activities to achieve the BP functional objectives.
- The consideration of role based activities. Indeed, the role concept is very important in the BP context. Each activity is performed by an actor to whom is assigned a role. Hence, controlling who is authorized to perform the BP activities in the SaaS environment is of a prominent importance. This implies assessing whether the SaaS service supporting the BP execution provides role based access control techniques.

Selecting the most appropriate SaaS service to support business process execution, is a large scale optimization problem that can be resolved by applying meta-heuristic methods. Hence, we propose the use of the Genetic Algorithm (GA) [1].

The sequel of the paper is as follows : Section 2 details our proposed system along with its different modules, Section 3 gives an overview of the related work, Section 4 evaluates our system. In order to subjectively evaluate this research work, we present the threat to validity in Section 5. We conclude finally in Section 6.

2. The system overall process

Fig. 1 illustrates the system activities it follows in order to compose a business process based SaaS composition.

The Business process is among the main data input for the system which is represented using the Business Process Model Notation (BPMN) [2]. The process owner is an enterprise aiming to achieve its business objectives through the outsourced BP. Consequently, the final SaaS composition should ensure as much as possible functionalities required by BP activities. The different cloud services are gathered based on well known repository such as cloud harmony.

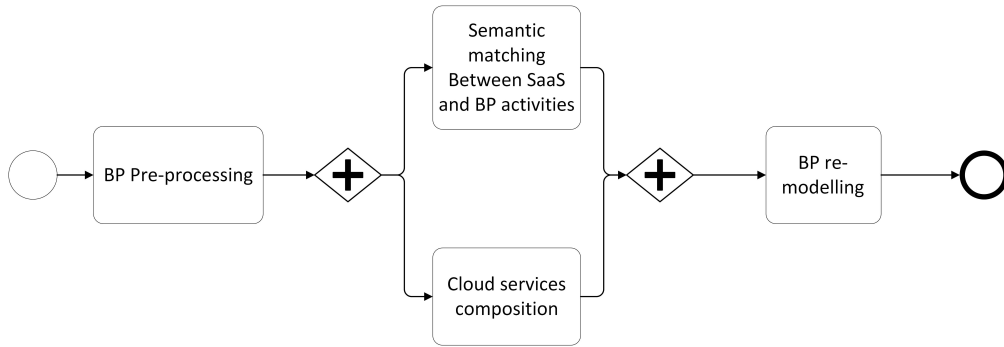


Figure 1: System process.

The most prominent gathered data related to SaaS services are: the service provider, the offered functionalities, the data access and the role based access control techniques.

The proposed system follows four main activities, namely : The BP re-construction, the semantic matching computing , the SaaS composition and finally, the SaaS modeling activities.

2.1. The BP re-construction

To guaranty keeping as much as possible the business process control flow and to simplify the outsourcing task, the BP re-construction aim is to decompose the business process into a hierarchy of sub-process having each one a Single Entry and a Single Exit (SESE) [3]. Each SESE fragment is considered as a black-box whose functionalities are supposed to be executed by a SaaS service. Fig. 2 illustrates an example of a BP decomposed into a set of SESE fragments. Each fragment presents a potential solutions to be outsourced.

As the Figure illustrates, the BP encompasses five SESE fragments. The fragment 1 is the root of the sub fragments 2 and 5. Hence, we impose as constraints that if the root is outsourced, its sub-fragments cannot be outsourced and if the sub-fragment is outsourced, the root cannot be outsourced. This constraint is imposed to guaranty a correct outsourcing without overlaps. This constraint is considered in the cloud services composition activity to guarantee a well synchronized BP execution while supported by cloud services.

2.2. Semantic Matching activity

We propose in this section, a semantic process aiming to match each BP activity with its data object with the SaaS offering and its input/output data. More specifically, we propose a process based on the extraction of semantics from the SaaS service Web pages to match the appropriate SaaS service to each BP activity. To do so, BP activities and SaaS services should have similar syntactic patterns. To attain this objective, we concentrate on a combination of statistical, linguistic as well as semantic analysis. Regarding that each SaaS Web pages contains a set of services which is by itself composed of a set of sub-services, it is essential to depict some hidden knowledge in each service description to extract its semantic description. For instance, supposing that a BP activity label is "Submission of an invoice", when applying

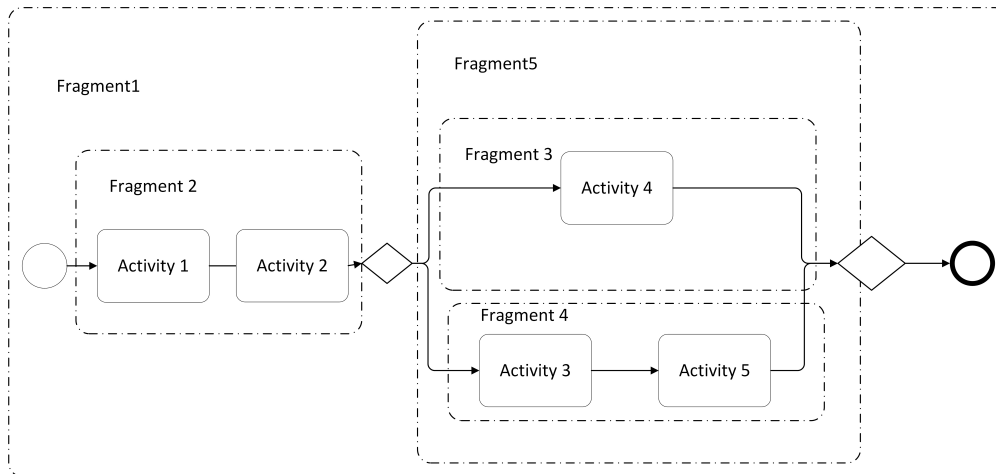


Figure 2: Illustrative example

the harmonization algorithm, we get the Action "submit" and the Business Object "invoice". Concerning the SaaS service, we store each solution labels into a dedicated database. For instance, the SAP concur1 is a SaaS service proposing a set of travel management solutions, such as expense products, travel products, invoice products, etc. Furthermore, each service is composed of a set of sub-services. Considering the same SAP concur1 service, it proposes a set of sub-services such as: "Broad inventory for global travel booking solutions", "Reports guide informed business decisions", "Travel planning that keeps every employee compliant", "E-receipts speed up expense claim creation and submission", etc. These sub services' labels are harmonized so as to be syntactically similar to the activities' ones. To define the semantic matching activity, three different processes are used:

- (i) To extend the scope of the BP activities' label, we used the lexical and the semantic dataset Wordnet dictionary [4] by applying the synonyms and hyponyms of all BP activities' labels. In fact, the Wordnet is a large lexical database of nouns, verbs, adjectives and adverbs which are categorized into sets of cognitive synonyms, each expressing a distinct concept.
- (ii) To extract the knowledge of the SaaS services description, we start first by a pre-treatment phase. This phase is based on four steps to obtain significant terms: the tokenization of all sentences in each description, the remove of all stop words using Porter algorithm, the lemmatization of each term using the Stanford lemmatizer. Thereafter, to extract knowledge, we used two techniques:
 1. The statistic technique TF-IDF to evaluate the importance of each term in the SAAS Web pages description, in relation to the BP activities' labels. In fact, the TF-IDF technique is most important and used frequently in the literature revues to prove the relevance of terms between others.
 2. The semantic similarity measures "Wu and Palmer" (Chabi et al., 2011) to measure the similarity between also the SAAS functionalities description and the BP activities'

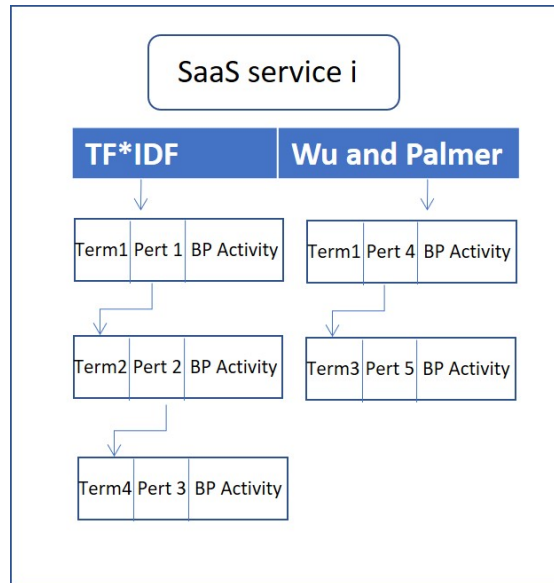


Figure 3: Illustrative example of the obtained result by applying the TF-IDF and Wu and palmer

labels. Several semantic similarity measures are proposed in the literature such as Cosine, Jaccard, Dice, Overlap, etc. Our choice is oriented to the taxonomic measure “Wu and Palmer” because it requires the existence of a taxonomic hierarchy between the different terms and concepts. In this paper, the taxonomic hierarchy is between SAAS functionalities services and sub-services. If the obtained measure result between the SAAS functionalities description and the BP activities’ labels admits a non-zero value, a semantic relationship exists. The obtained results represent a set of terms related to each SAAS functionalities related to the BP activities’ labels with a pertinence value extracted using the TF-IDF technique and the “Wu and Palmer” similarity measure. Figure 3 showed an example of the obtained result.

(iii) Identification of pertinent matching between SAAS functionalities description and the BP activities’ labels: By applying the TF-IDF and the “Wu and Palmer” technique, each SAAS functionalities is represented by a set of terms ‘Ti’ through the two techniques. In the other words, each generated term from the TF-IDF and the “Wu and Palmer” technique is related to the BP activities through a pertinence value as showed in Figure xxxx. To identify the corresponding SAAS functionalities to the BP activities’, we find it is prominent to measure the pertinence of each SAAS functionalities based on each generated terms from the two used techniques. In fact, we propose first, measuring the pertinence of generated term. Figure yyyyy showed an example of Each SAAS Functionalities “SF” contains one or several terms ‘Ti’, and each term ‘Ti’ has at least one representative value related to the BP activities. Two cases are then possible:

- If the term “Ti” refers to the BP activities through the TF-IDF and the “Wu and Palmer” then the weight “wTi” of the term “Ti” is the represented by the following

formula:

$$wTi = \max(Pert_TI_TFIDF, Pert_TI_WuPalmer) \quad (1)$$

Where: $Pert_TI_TFIDF$ is the obtained value of the term “Ti” using the TF-IDF technique and $Pert_TI_WuPalmer$ is the obtained value of the term “Ti” using the “Wu and Palmer” measure.

- If the term “Ti” refers the BP activities through only a single value (from the TF-IDF or the “Wu and Palmer” then the weight “wTi” of the term “Ti” is the represented by the following formula: The pertinence of a genre ‘C’ is measured by the following formula:

$$wTi = Pert_TI \quad (2)$$

Then, the pertinence of each SAAS functionalities is measured by the following formula:

$$\frac{\sum_{n=1}^{nb} wTi}{nb} \quad (3)$$

where “nb” represents the number of terms according to the SAAS functionalities ‘i’. The SAAS functionalities having the highest pertinence represents the corresponding SAAS to the BP activities.

2.3. The cloud services composition activity

The cloud services composition activity is very important in our research context. The input of this activity is the BPMN model subject of the BP to be outsourced to the SaaS services as well as its data model. Its aim is to allocate SaaS services to each SESE fragment in the way that the allocation ensures:

- A greater matching between the BP required functionalities and those of the selected SaaS;
- Avoiding outsourcing BP fragments, requiring a considerable amount of external data access, to a set of SaaS services that do not handle data access techniques;
- Outsourcing to SaaS services holding role based access control techniques once the outsourced BP activities require to be handled by specific role(s).

From the computational point of view, selecting the most suitable SaaS service for each business process SESE fragment, is a large scale and complex optimization problem that can be resolved by applying methods for combinatorial optimization. To select the optimal set of SaaS services from a variety of SaaS offers, our proposed resolution approach adopt a heuristic technique namely the genetic algorithm.

Genetic algorithms (GA) [1] belong to the evolutionary algorithm families. These algorithms’ principle is the simulation of the population evolution. A population is composed of a set of solutions called also chromosomes or individuals. These chromosomes undergo various genetic operation, such as crossover and mutation. Among the strengths of the GA is the evaluation

of each solution quality in the aim to keep only those considered as of a good quality. In what follows we detail the proposed GA. More precisely, we first present the chromosome representation. Then, we present our algorithm for the SaaS allocation to each BP fragment. A report on the algorithm performance is presented in Section 4.

2.3.1. Chromosome representation

A chromosome in the SaaS allocation/composition problem, represents a SaaS offer that would potentially support the execution of an SESE fragment. Hence, two basic compartments constitute the chromosome. The first one $C1$ corresponds to the $SESE_s$ fragment and the second compartment $C2$ is related to the SaaS offer SL_x supporting the execution of the $SESE_s$ identified in $C1$. Is is straightforward mentioning, that the application of the GA is realized multiple times to identify several SaaS that potentially would support the execution of the BP fragments. Instead of representing a chromosome as a set of SESE fragment and the related SaaS offering, we believe that using the proposed representation is more efficient as it simplifies the fitness function detailed in what follows.

2.3.2. Fitness function

Equation 2 formalizes our objective function for the genetic algorithm. The value given by this function is called the fitness value, and it is used to evaluate the quality of the obtained solution.

$$f(x) = \frac{1}{nb_{SESEact}} \times [W_1 \times \sum_{i=1}^n \sum_{j=1}^m \text{Max}(\text{sim}(AL_i, SL_j))] \quad (4)$$

$$+ W_2 \times \left[\frac{1}{nbData} \times \sum_{i=1}^n \sum_{j=1}^m \text{Max}(\text{sim}(DA_i, DS_j)) \right] \quad (5)$$

$$+ W_3 \times \left[\frac{nbDAT_{Sl}}{nbT_{DAT}} \times \frac{1}{nbR_{SESE}} \right] \quad (6)$$

$$+ W_4 \times \frac{1}{1 + nbIOD_{SESE}} \quad (7)$$

Where $\sum_{i=1}^4 W_i=1$ is the weights for each equation in the fitness function.

Line 1 of the fitness function focuses on functional similarities between activities and SaaS, while line 2 compares the data similarity between each SESE and the SaaS managed data. Within an individual, the SaaS may be composite, composed of other services (SAP concur is a composite SaaS), or atomic (for instance, the sub-product "Travel planning that keeps every employee compliant"). In the case of a composite SaaS, its overall sub-products are evaluated in a way that allows to identify for instance, that $SESE_3$ (see Fig. X) should be supported by the SaaS "SAP concur".

The line 3 of Equation 2 aims at maximizing the number of role based access control techniques of the adopted SaaS provider proportionally to the number of roles within the SESE fragment. Hence, the fitness function evaluates the number of SaaS access control tools $nbDAT_{Sl}$ provided

by the adopted SaaS provider. nbT_{DAT} is the total number of the most popular and prominent SaaS access control tools [5] namely:

- Intel Expressway cloud Access 360
- Visual Guard
- Based (SaaS) IP access control
- SaaS-based Access Control Solutions
- SaaS Security: cloud Access Control
- Cisco Software-as-a-Service (SaaS) Access Control

Finally, $\frac{1}{nbR}$ refers to the total number of roles in the outsourced SESE fragment. In other words, if the number of roles is important but the adopted SaaS providers do not provide sufficient access control tools, then the $\frac{nbDAT_{SI}}{nbT_{DAT}} \times \frac{1}{nbR_{SESE}}$ value is low. It is straightforward to mention, that if $nbDAT_{SI} = nbT_{DAT}$ then computing $\frac{1}{nbR_{SESE}}$ is omitted as the SaaS provider offers the required access control tools so that the number of roles within the SESE is not important.

The equation in line 5 evaluates the number $nbIOD_{SESE}$.

2.3.3. Crossover and mutation

The crossover and the mutation are two genetic operators representing fundamental elements in the GA. For the crossover operator, we use the single point one respecting a predefined probability P_c .

A chromosome is also subject to a mutation operation according to a mutation probability P_m . It is applied to change whether a SESE fragment, or a SaaS service.

2.4. SaaS modeler module

The BP owner lacks in general the sufficient knowledge and expertise related to cloud and more specifically to SaaS model. As the business process execution is supposed to be entirely supported by a composition of SaaS services, transforming the outsourced business process model along with its activities to the target SaaS composition is of paramount importance for BP owner.

Hence, we propose (i) an extension of the BP meta model in order to be able to illustrate required elements for the SaaS composition namely, the SESE fragment and its relation with other BP elements and the explicit details related to the BP input and output data (ii) a new SaaS meta model allowing to make in evidence how each BP element is handled in SaaS. (iii) We propose finally a model to model transformation from business process model to SaaS model. This transformation is based on a set of transformation rules we propose but we omit in this section as it is not the focus of the paper.

3. Related Work

Even though the business process outsourcing to the cloud is not a recent research area, several works and propositions are elaborated in order to propose a standard process to safely and

Table 1

The used GA parameters.

Parameters	Description
Population size	100
Selection technique	Tournament selection
Termination condition	Stability of fitness function
Crossover probability	0.5
Mutation probability	0.015

effectively outsource a business process to the cloud [6, 7, 8]. In this context, [9] proposes an open and interoperable framework called CloudSocket, providing BPM solutions in the cloud for small and medium sized enterprises. [10] proposes a semantic framework for BP as a service configurable models, benefiting from the advent of available Web semantic researches. Furthermore, a comprehensive framework for business process outsourcing is proposed in [11], focusing on outsourcing BP to IaaS model based on outsourcing criteria such as, cost and risk minimization and focus on core competencies. The authors in [8] focus on a specific phase of the BPM in cloud life-cycle, namely the BP as a service modeling, providing hence facilities for both business and IT experts when adopting cloud to support business processes execution.

Recently, SaaS model become among the wise choice of enterprises as a mature alternative of their in-premise applications or to support the BP execution. [12] propose a layer based configuration architecture dividing logically, business process into three layers: business layer, service layer, and data layer. According to the specification of each layer, authors propose a set of configuration strategies. The configuration architecture can be applied in SaaS model to meet the personalized requirements of tenants. Tan et al. proposed in [13] an evaluation method to assess the on-premise IT infrastructure and the enterprise readiness for SaaS adoption. This method employs a mixed of quantitative and qualitative approaches that are used in deciding and identifying suitable business operation to be migrated to SaaS.

4. Experimental evaluation of the SaaS Allocator

The objective of our experimental evaluation of the performance of the SaaS Allocator is to evaluate the ability of the GA to identify optimal solution, i. e. the best SESE to outsource and the appropriate SaaS to support its execution

We implemented the genetic algorithm using the Java language. In our experimented implementation of the genetic algorithm, we have fixed its characteristics as depicted in table 1.

4.1. Experiment

To evaluate the performance of the GA, we use a real case related to a BP of travel agency.

The BP is constituted of 7 SESE fragments. It is straightforward to mention that the BP is simplified so the number of SESE fragments is reduced for simplifications sake. The main purpose of the BP is to manage the customer quote through the calculation of the flight, hotel,

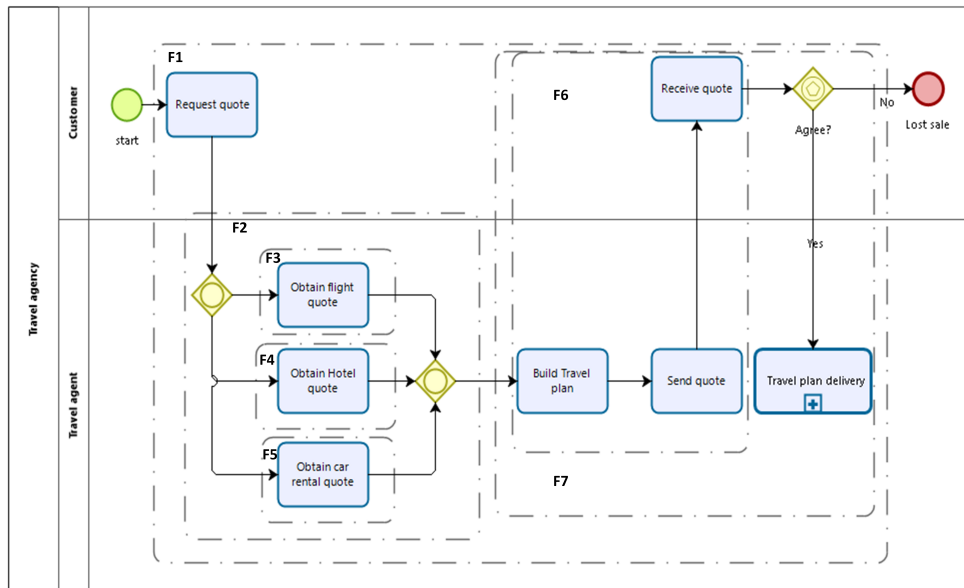


Figure 4: A travel agency business process

and car rental quotes.

Concerning SaaS services, we evaluate the overall collected services through the internet whose number surpasses 8000; constituted of services and their sub-products. The SaaS labels refactoring is applied only for the services selected by the SaaS allocator module.

When applying the GA, the best solution identified corresponds to outsourcing the SESE fragment F2 to SAP Concur. This SaaS service ensures managing travels through multiple set of services namely, the expense management, the travel solutions and the invoice automation. The travel solutions encompasses services covering, car rental through the service "select car rental company", Hotel Reservation Services (HRS), travel control and report through the sub-product "TripLink".

In the following, we will present firstly, an example of the calculation related to the semantic similarities between the SESE fragment F2 activities/ data to be outsourced and the adopted SaaS/ data. The required input data for the F2 fragment are: the customer data constituted of his personal information as well as his travel data (car rental, flight and hotel). The output data corresponds to the customer travel quote which is used by the fragments F6 and F7.

$$\text{Sim_Act}(\text{Obtain_carrental}, \text{select_car_rental}) = \frac{2}{6-2} = 0.5$$

$$\text{Sim_DataIn}(\text{car_rental_data}, \text{car_rental_Company}) = \frac{2}{6-2} = 0.5$$

For both similarities (activity and data labels), the calculated value is 0.5. The value 2 corresponds to the number of similar terms and 6 is the total number of terms in both labels. Indeed, for the similarity between the activity and the SaaS service label, car_rental is used in

both labels. However, as "obtain" and "select" are not synonyms, their similarity value is equal to 0.

The performance evaluation is based on the comparison between the GA results with the Round Robin (RR) and the Greedy ones. For the Round Robin algorithm, the most appropriate solution to adopt is outsourcing the fragment F6 to the hunter¹ SaaS. The best solution related to the Greedy algorithm is to outsource F7 to the Concur service. Table 2 illustrates the best solution identified (based on the fitness function) of each algorithm.

Table 2

A comparison between the best solution of the RR, greedy and GA algorithms

Algorithm	Number of SF roles	$nbIOD_{SF}$	Selected SaaS Sl	$nbDAT_{Sl}$	P
GA	1	2	SAP Concur	Not provided	1
RR	2	2	hunter	Not provided	0
Greedy	2	3	SAP concur	Not provided	0.5

According to the provided results of the different algorithm, the GA provides better solution in terms of number of roles, number of exchanged data and the precision. The precision computes the similarity of each SESE activity with the provided services of each selected SaaS.

5. Threats to validity

Although the good performance of the SaaS allocator module and its ability to match activities required functionalities with the SaaS ones, we observe some limitations related to the semantic matching module. Indeed, some SaaS providers use specific and not expressive terms to label their services which harden the task of matching the activities to the appropriate services.

6. Conclusion

This paper proposes a comprehensive framework for business process based SaaS composition. The framework is constituted of four basic modules namely, the BP decomposition, the semantic matching, the SaaS allocator and the SaaS modules. These modules allow to fill the gap between the BP and the SaaS services available on the Internet. Finding out the suitable BP fragment to outsource along with the SaaS to adopt is not a well-worn task regarding the complexity of the BP structure (i. e. number of activities, number of exchanged data, and number of roles). Hence, we propose, in the SaaS allocator module a genetic algorithm allowing to find good solutions in different cases.

Actually, we are working on proposing, in addition to the objective selection of the SaaS to adopt, a subjective evaluation of these cloud services, based on users feedback from social media. Combining objective and subjective evaluation gives a more pertinent solutions.

¹<https://hunter.io/>

References

- [1] M. Mitchell, *An Introduction to Genetic Algorithms*, MIT Press, Cambridge, MA, USA, 1998.
- [2] OMG, *Business Process Model and Notation (BPMN), Version 2.0*, 2011. URL: <http://www.omg.org/spec/BPMN/2.0>.
- [3] R. Uba, M. Dumas, L. García-Bañuelos, M. La Rosa, Clone detection in repositories of business process models, in: *International Conference on Business Process Management*, Springer, 2011, pp. 248–264.
- [4] G. A. Miller, Wordnet: A lexical database for english, *Commun. ACM* 38 (1995) 39–41. URL: <http://doi.acm.org/10.1145/219717.219748>. doi:10.1145/219717.219748.
- [5] S. Rehman, R. Gautam, Research on access control techniques in saas of cloud computing, in: *International Symposium on Security in Computing and Communication*, Springer, 2014, pp. 92–100.
- [6] T. Barton, C. Seel, Business process as a service - status and architecture, in: *Enterprise modelling and information systems architectures - EMISA 2014*, Luxembourg, September 25-26, 2014, 2014, pp. 145–158.
- [7] S. Schulte, C. Janiesch, S. Venugopal, I. Weber, P. Hoenisch, Elastic business process management: State of the art and open challenges for bpm in the cloud, *Future Generation Computer Systems* 46 (2015) 36–50.
- [8] K. Hinkelmann, K. Kritikos, S. Kurjakovic, B. Lammel, R. Woitsch, A modelling environment for business process as a service, in: *International Conference on Advanced Information Systems Engineering*, Springer, 2016, pp. 181–192.
- [9] R. Woitsch, W. Utz, Business process as a service (bpaas), in: *Conference on e-Business, e-Services and e-Society*, Springer, 2015, pp. 435–440.
- [10] K. Yongsiriwit, N. Assy, W. Gaaloul, A semantic framework for configurable business process as a service in the cloud, *Journal of Network and Computer Applications* 59 (2016) 168–184.
- [11] M. Rekik, K. Boukadi, H. Ben-Abdallah, A comprehensive framework for business process outsourcing to the cloud, in: *2016 IEEE International Conference on Services Computing (SCC)*, 2016, pp. 179–186. doi:10.1109/SCC.2016.30.
- [12] C. Han, C. Wu, W. Gong, Research on saas oriented business process customization method, in: *2016 9th International Symposium on Computational Intelligence and Design (ISCID)*, volume 2, 2016, pp. 412–416. doi:10.1109/ISCID.2016.2103.
- [13] C. Tan, K. Liu, L. Sun, A design of evaluation method for saas in cloud computing, *Journal of Industrial Engineering and Management (JIEM)* 6 (2013) 50–72.