

Inhance deep customizations in a multi-tenant SaaS application using the BPMN

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Abstract. A multi-tenant application aims to provide a single instance of an application with the capability for each organization to have its own specific functionalities. Recent researches have proved the efficiency of the intrusive and non-intrusive approaches in providing deep customizations. However, deep customizations are still limited to the features provided for each organization. In order to enhance the deep customization, we propose a BPMN-based customizations to provide to each organization the capability to create its own features. such a method requires an administration module to provide to the organization to create forms, scripts and notifications to be integrated in a BPMN workflow's tasks. Such a method has proved its capability to introduce new functionalities using understandable graphical representations which reduce the need for the vendors' intervention.

Keywords: Multi-tenancy, BPMN, deep customizations, workflow

1 Introduction

A multi-tenant SaaS application aims to provide a single instance of an application with the capability for each organization to have its own specific functionalities. Providing the customizations to each organization as microservices is a costly task as it requires the from the organization that provides the service to provide the implementation of the new functionalities and add the needed configuration to make it accessible by the specific tenant that has asked for those customizations. In order to reduce the cost and time of multi-tenant SaaS customizations, we propose to use the Business Process Management and Notation (BPMN) to provide for each organization to create its own customizations by introducing and modifying executable workflows by simply doing a drag and drop of components. However, the BPMN tasks require to be configured to ensure the workflow deployment. For this reason, we proposed to define an administration module that provides UIs to the tenant to facilitate the preparation of the configuration relevant to the tasks and facilitate its integration in the workflow by customizing the BPMN.io¹ extension. Our method has proved its capability in defining new functionalities in a short time and is cheaper than intrusive and non-intrusive customizations due to the SaaS pay-as-you-go feature.

The major contributions of this paper are twofold. First, we propose a BPMN-based customization method. Then, we provide a demonstration of deep customizations through a BPMN-based multi-tenant SaaS application as a case study.

The rest of the paper is organized as follows, section 2 provides the background of our research work. Section 3 presents the proposed method. The demonstration of BPMN-based multi-tenant SaaS application case study is provided in section 4. Finally, we conclude with the conclusion and future work.

¹ <https://bpmn.io/>

2 Related work

2.1 Multi-tenancy

Providing tenant-specific customization in a multi-tenant SaaS is a challenging task [1]. By using intrusive custom microservices, Song et al. [2] proposed an architecture for multi-tenant SaaS customization. The intrusive microservices aim to provide accessibility to the customizations that are introduced in separate microservices by registration and mapping of the customizations using tenant managers. So, once the tenant request reaches this part, it will be redirected to the registered microservice. However, Nguyen and Muller [3] propose a non-intrusive customization framework called MISC-CLOUD. MISC-CLOUD allows the Multi-tenant SaaS customization through an API gateway to manage the authority of customization's API calls. Both intrusive and non-intrusive approaches allow deep customization of multi-tenant SaaS applications [4]. However, to provide the flexibility to adapt to the specific-tenant's changing requirements, the BPMN represents a good solution due to its capability in creating executable workflows using easy graphical customizations [5, 6].

2.2 BPMN

The BPMN is a visual modeling language for business processes that helps to create executable workflows [7]. In BPMN, pools are used to present a participant in a collaboration. Each pool can contain multiple lanes which helps to further organize the workflow's activities [8]. Recently, several researches have been conducted to improve the BPMN capabilities. On one hand, Ribeiro et al. [10] introduced a new BPMN extension that aims to Model Inter-Organizational Processes. On the other hand, Delgado et al. [9] proposed a model-driven approach to deal with the BPMN variants. The use of the BPMN to model executable business logics enhances the tenant-specific deep customization in a multi-tenant SaaS application by reducing cost and time of production.

Form.io Form.io is a framework that facilitates the creation of forms by using the drag and drop feature [11]. Due to the use of APIs, Form.io created forms can be easily shared and exploited in customizable applications. Moreover, as the BPMN's 'start event' and 'user task' must contain a form to be filled, the Form.io created forms can be easily integrated. To this end, we exploited the Form.io form builder to create forms for the BPMN workflow.

3 Methodology

In order to propose deep customizations in a multi-tenant SaaS application, that reduce the cost and time of production, we propose to provide an administration module that provides each tenant with the capability to create its own customizations. The main component of this module is the BPMN workflows constructor. It helps to create executable workflows. However, as the different tasks in the BPMN require to be configured so it can be deployed and executed, we provide the necessary components to prepare the needed configurations. First of all, we have the form builder that uses the Form.io extension to provide to the tenant the capability of creating forms using the drag and drop feature. The created forms can be easily integrated in a 'user task' or a 'start event'. Then, we provide the notification builder which helps to configure the emails so it can be integrated in the 'send task'. Also, we provide a script builder to introduce a groovy script that can be integrated in a 'script

task’. Otherwise, the service provider can provide the other customizations in microservices using JavaDelegate that can be called from a ‘service task’.

To proceed to the workflow deployment and execution, we provide a microservice that aims to add the executable process to the menu and configure the notification of each user task as well as the fields to be shown in the table relevant to this process. At that time, by accessing the menu relevant to the process, a tenant can create a new instance of the process and access the historical variables relevant to completed as well as uncompleted processes’ executions.

4 Experimentation

As experimentation, we provide an illustration of a BPMN-based multi-tenant SaaS application developed from scratch. In order to illustrate the BPMN-based customization, we provide an example of a workflow that contains a ‘start event’, a ‘user task’, a ‘send task’ and a ‘script task’ to explain their configuration.

Fig. 1: The form builder UI

First, we proceed to the Form creation for the ‘start event’ and the ‘user task’ as shown in figure 1. Then, we proceed to create the configuration of the emails in the notification builder for the ‘send task’ as represented in figure 2. Thereafter, we present the creation of a simple script using the script creator for the ‘script task’ as shown in figure 3. Finally we proceed to the workflow creation and the tasks configuration as represented in figure 4.

Once the workflow is ready, we start to prepare the deployment and the configuration of the notification and table of instances which is represented in the figure 5a , figure 5b and figure 5c respectively. The execution of the workflow now becomes possible by accessing the process from the menu and filling the start event form and all historical data still accessible from the table of instances which is represented in figure 6.

Fig. 2: The notification builder UI

Fig. 3: The script builder UI

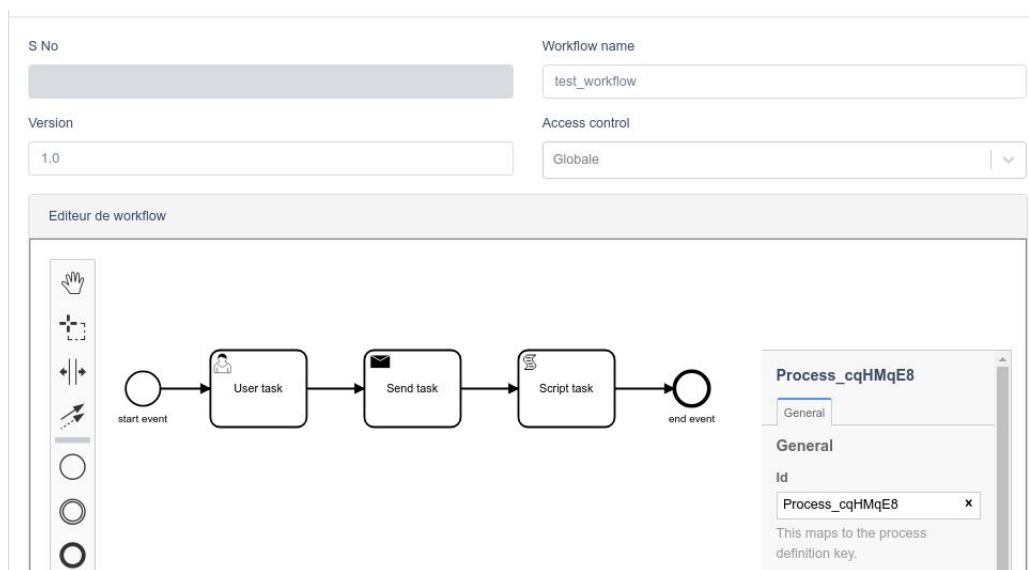


Fig. 4: The workflow builder UI

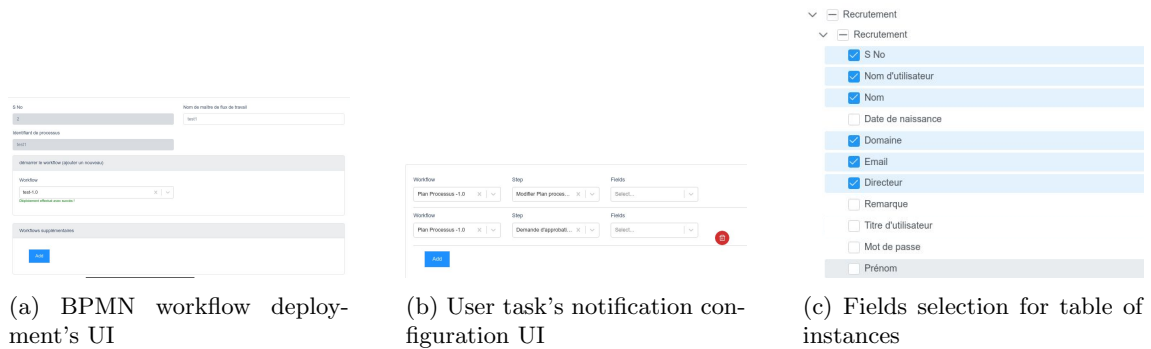


Fig. 5: Process' preparation from the BPMN workflow

S No ↑↓	Type de système de gestion ↑↓	Départements ↑↓	Nom du processus ↑↓	statut approuvé ↑↓	Autorité d'approbation ↑↓
1				approuve	amira23
7					amira23

1 of 1 pages (2 items) 10

Fig. 6: List of process instances' historical variables

5 Conclusion and future work

In this paper, we proposed a BPMN-based customizations in a multi-tenant SaaS application. A demonstration of the proposed method is illustrated in a BPMN-based multi-tenant customizable SaaS application. Due to the UIs used to introduce the new executable business logics and its configuration, our method has proved its capability to reduce the time of production as well as the cost of customizations.

As a future work, we aim to provide the semantic interoperability over the BPMN processes instances and integrate the artificial intelligence to further enhance the capability of our method.

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