

A Feasible Approach to Emergency Response Plan Digitalization and Cooperation

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Abstract. Emergency Response Plan (ERplan for short) plays an important role in carrying out emergency rescue effectively during the emergency response process. Unfortunately, the fact that ERplans are generally stored in form of text exposed some problems such as disunited standard, poor operability and so on, which affected the efficiency of emergency response, especially for cooperation of emergency response. In order to solve the deficiencies of text-based ERplan, the paper presents a feasible approach to digitalize the ERplan using workflow technology. For developing the ERplan workflow designer, the special features of ERplan are illustrated and modeling of business process of Tianjin overall ERplan with Petri Net was described in detail. Finally, the prototype of the emergency response cooperation platform based on ERplan workflow was developed to support the cooperation of inter-organizational for emergency response. The results showed that ERplan workflow provided a feasible solution for improving the performance of emergency response process.

Keywords: Emergency Response Plan Digitalization; Workflow; Inter-organizational Workflow Cooperation

1. Introduction

High priority was given to the building of emergency response information platform in “National Program for Medium-to-Long-Term Scientific and Technological Development” [1]. Emergency response plans are the scientific plan and scheme made in advanced by government or enterprise to carry out the emergency succor efficiently and effectively, to abate the incident loss and is an important basis of emergency process. ERplan in form of text is always facing some issues such as confused expression and difficult to carry out. It’s urgent that strong step should be taken to improve the poor performance of emergency response due to the text-based ERplan.

Workflow technology provides a framework for business process model analysis, establishment and management. It’s widely used in the enterprise business process and government services. Therefore, the way using the workflow technology to tackle the issues faced emergency response currently makes great sense. So developing an ERplan workflow designer which is suitable for emergency response and exploring an approach to achieve the cooperation of emergency response process are the primary tasks.

Firstly, this paper proposed a reference model of ERplan workflow on basis of ERplan and workflow model proposed by WfMC(Workflow Management Coalition) [2]. Then, this paper shows modeling of business process of Tianjin overall ERplan with Petri Net. Accordingly, we summarize the special features of the emergency response process for the digitalization of ERplan.

There’re some researches on inter-organizational workflow cooperation [4] [5] [6] [7]. In the context of e-government services, broadly there are three ways of structuring workflows in inter-organizational processes

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[8]. Base on analysis of emergency response instances, this paper draws a conclusion that centralized cooperation method and integrating sub-processes workflow structuring [8] is a feasible approach to emergency response process. SOA (Service-Oriented Architecture) has been introduced to solve the inter-organizational workflow cooperation [9] [10]. ESB(Enterprise Service Bus) is a practical way to implement the SOA [8]. Consequently, this paper explores the way with ESB to achieve the cooperation between organizations concerned emergency response process such as police bureau, fire bureau and so on.

Finally, the prototype of the emergency response cooperation platform is introduced and further work going on is illustrated briefly.

2. ERplan Workflow Digitalization

2.1 ERplan workflow reference model

Workflow reference model is defined by the WfMC(Workflow Management Coalition) [2].

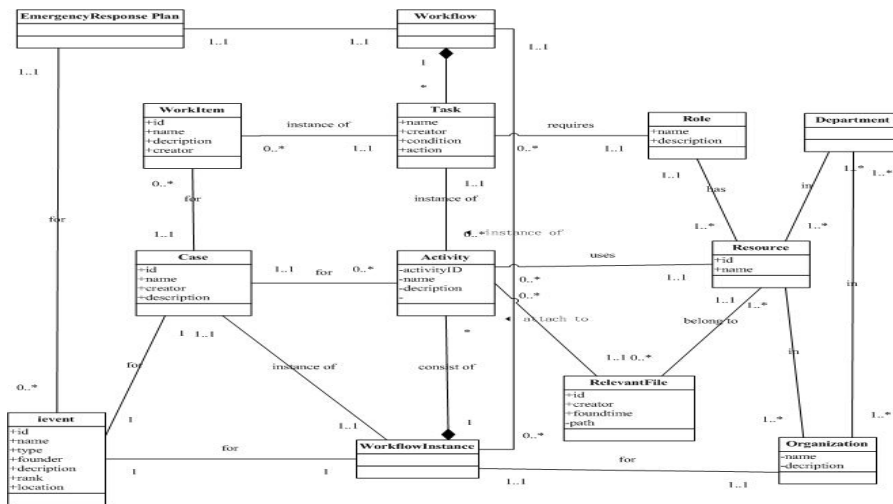


Figure 1. Emergency response reference model

It specified the construction of a workflow system and explained the constitution of workflow. This paper provides a reference model of emergency response workflow according to workflow reference model. Figure 1 shows the ERplan workflow reference model. The model presents the elements of emergency workflow. It contains three parts, including resource model, organization model and process model.

The resource model contains objects as “Resource”. Organization model refers to “Role”, “Organization” and “Department”. Process model refers to “Emergency Response plan”, ”Workflow”, “Workflow Instance”, “Case”, “Task”, “Activity” and “WorkItem”. According to the figure, the “WorkItem”, “Workflow Instance” and “Activity” are the instances constituting a workflow instance.

2.2 ERplan workflow digitalization

Figure 2 shows a workflow instance of Tianjin overall emergency plan. The workflow model is described with Petri Net. To obtain more detail about application of Petri net to workflow, please consult [3]. According to the Figure 1 and Figure2, a conclusion can be drawn that the emergency response workflow is usually event-driven and resource-driven.

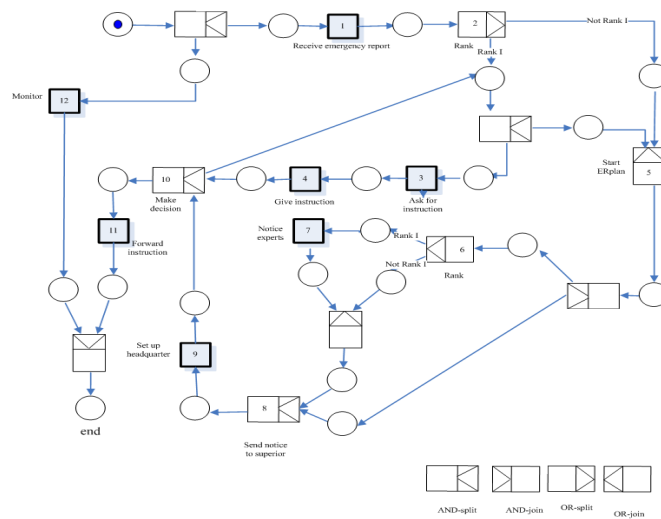


Figure 2. Tianjin overall emergency response plan

It's the special feature of the emergency process that almost all activities or tasks of the process should be driven by human or events to move it forward. Therefore, the event-driven mechanism can be utilized to implement the workflow designer and standard activities based on event-driven will be enough to construct an ERplan workflow. As a consequence, there are two kinds of activity required to construct the ERplan workflow as follow.

- Routing Activity
- Standard emergency process Activity

Routing activities are responsible for routing the ERplan workflow such as permission checking and decision making. Two kinds of routing activity should be provided; one is that the condition of the activity is decided according to the parameter of runtime environment and the other one's is decided by human while workflow instance is running.

The standard emergency process activity is the core of the ERplan workflow. To describe the task of the emergency process activity, a task form is attached to each activity. The task form describes the properties of the task relevant to the activity. The properties include person directly responsible, duty and timing and so on. Furthermore, some utility functions should be provided such as sending email or message to people relevant to current activity. The person on duty can learn the details from the task form and response to the activity accordingly.

2.3 ERplan workflow management system

ERplan workflow management system is the host server of ERplan workflow instances. The WfMC defines the workflow management system detailed. Workflow system base on B/S framework takes good advantages of internet, it is easy to deploy on the complicated and heterogeneous network. It provides the fundamental functions such as management the ERplan workflows and the organizational management as the organization model of the workflow reference model. It also provides the operation interfaces of the person on duty.

ERplan workflow management is similar to the workflow management system defined by WfMC other than that it's not only a workflow management system but also a GIS(Geographic Information System) which providing the geographical information for the emergency response. Especially, 3S technology is also used to facilitate emergency response.

3. Cooperation of Inter-organization for ERplan Workflows

Autonomy and distribution are the key features of resources of emergency response management system. Nowadays, the 3rd generation emergency response platform has been formed. The General Office of government is the center of the platform [16]. There are three ways of structuring workflows in inter-organizational process. The public process approach preserves the autonomy of different organizations [8]. To

build interoperable enterprise systems that are reliable and scalable while ensuring loose coupling among services and applications, ESB is a good solution [9]. ESB provides the common interfaces for data and business interaction while the applications of concerned organization provide interfaces to allow or simplify access for the ESB business process. To know about more detail about ESB, please consult [9]. The applications in this paper are the ERplan workflow management systems deployed at each concerned organization. The interfaces of the application are a set of web services. The figure 3 presents the framework of the cooperation platform.

There are two aspects of responsibility of the ESB. On the one hand, it is responsible for arranging the main cooperation process, providing the visual designer to design and reconstruct the cooperation process and the infrastructure to run and monitor the cooperation process. On the other hand, it provides the ability to exchange data between heterogeneous applications. Especially, it is achieved by message-oriented middleware and the message uses XML as a neutral format.

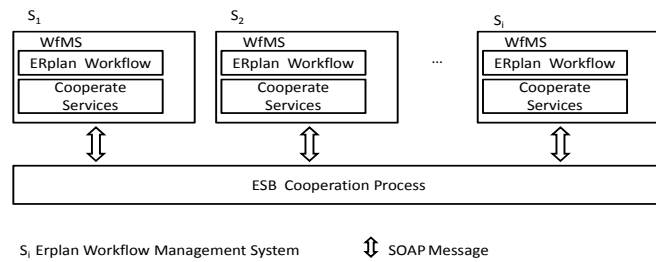


Figure 3. ERplan workflows cooperation platform

As a prerequisite for building the cooperation process, the policies of the cooperation should be established. The policies include three aspects as follow [14].

- Establishment of access contracts. It includes issues such as passport to access the cooperation workflow, the activities to participate in the cooperation of each application.
- Establishment of data exchange contracts. It includes issue that the exchange message schema to construct protocol, especially XML schema. During this phase, several neutral protocols documents would be established.
- Establishment of public view. During this phase, the interfaces of each participated application would be published, especially, some web services are provided.

There are two levels of inter-organizational workflows cooperation. One is case level and the other is activity level. The methods of the interaction vary with different cooperation levels. It should not share public conditions between different applications. The dependencies at application level can be achieved by resource driven [9]. This paper uses the event-driven mechanism to implement the interaction of the two levels business cooperation. Figure 4 and Figure 5 present the two levels interaction respectively of an instance. The instance ran on our prototype platform which will be illustrated follow.

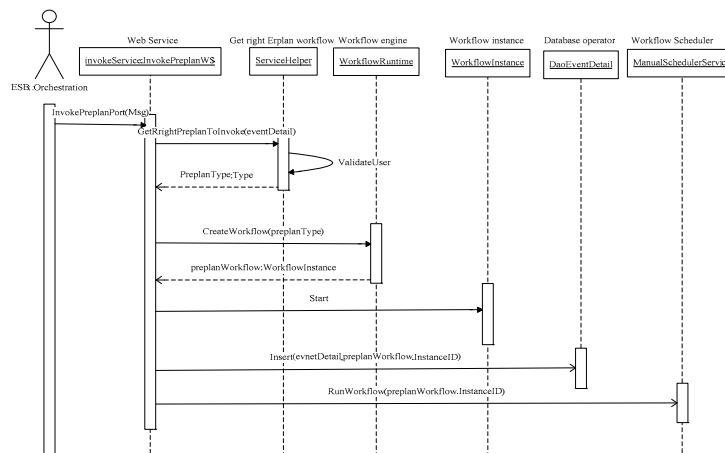


Figure 4. Cooperation on case level

At the case level, the workflow management systems publish a set of web services which can invoke workflows of the system. The ESB business process calls the web services to invoke the workflow instance. As on the BizTalk platform, the business process is known as “orchestration” [13].

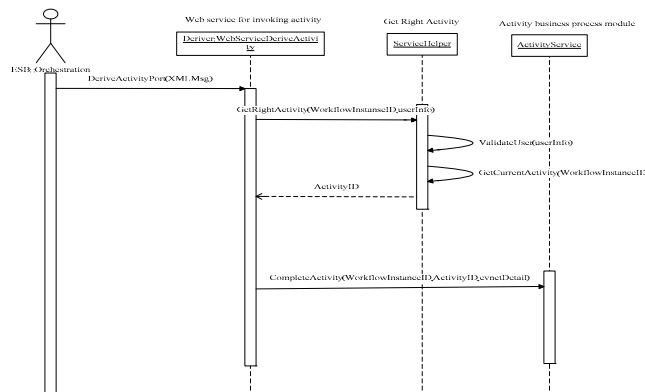


Figure 5. Cooperation on activity level

At the activity level, since the activities of the ERPlan workflow is event-driven, activity of workflow instance which is running can also be driven by the resources such as message and web service. The message may be passed by the business process or sent directly from the other application.

As stated previously, cooperation process can be built on the ESB platform and the ERplan workflow cooperation can be achieved.

4. Conclusion

The challenges being faced are all over the whole process of ERplan digitization and emergency response cooperation. This paper provides a feasible approach to facilitate the whole process. Figure 6 presents the whole workflow digitization process.

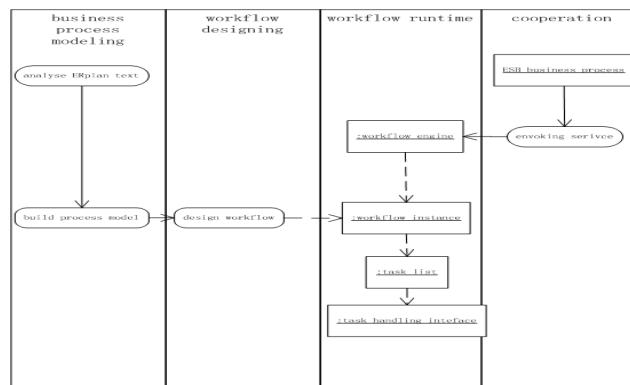


Figure 6. Activity diagram of ERplan digitalization

We had designed and developed a prototype of emergency cooperation platform. It includes an ERplan workflow designer and corresponding management system. We also built a cooperation process instance according to real emergencies to verify our approach. The result of the instance showed that the platform improved the performance of the emergency response effectively.

The ERplan workflow designer provides several standard activities based on event-driven. Using the activities, people can design ERplan workflow without any manual coding. The ERplan workflow designer used WF as workflow developing tools which is a free product of Microsoft .NET 3.0(and other higher version) [12]. We used BizTalk as the ESB platform to facilitate the cooperation process [13] [14].

The ERplan is usually not well-defined. To facilitate cooperation between independent and autonomous emergency response departments or organizations, there're still lots of issues to tackle. For further work, We will develop more standard activities of the ERplan workflow designer to facilitate the digitalization of ERplan and improve this approach by more real emergency instances.

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