

A Business Process Modeling Notation Extension for Real Time Handling - Application to Novel Coronavirus (2019-nCoV) management process

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Abstract—the need of real-time enterprises increases according to our life style and customers' satisfaction goal. Real-time business process is one of the important components of a real-time enterprise. For that, a formal definition of real-time concept and real-time process was indispensable. This work presents a formal definition of real-time concept, real-time ontology and a proposition of a real-time component with real-time attributes. This new dimension of time contains three components: latency time, acceptance interval and theoretical time. This definition gives a new vision of time, not just an ordinary vision as periods and calendar but as a response to our needs in real-time enterprises: real-time. Before the proposition of a real-time component for BPMN language, which we apply to Novel Coronavirus (2019-nCoV) management process, as case study.

Keywords-Real-time; Real-time process; Real-time Enterprises; BPMN language; Ontology; Business process; Coronavirus process.

Foreword—we notice that our definition of real-time is in Enterprise case management study. So, according to our definition of real-time, real-time processes and real-time enterprises, and to avoid any confusion with any other real-time definitions, we propose our new concept of real-time as right-real-time/right-time.

I. INTRODUCTION

Time is one of the most treasured resources in all companies and in different domains; it is important to react at the adequate moment and any latency may cause many problems as the financial one, and losing customers' satisfaction.

In BPMN, time is managed and modeled by event entity, which is sufficient in most cases to do necessary operations. However, real-time concept is not modeled or implemented.

Time axis is known by its importance in terms of respecting deadlines for example, that's why many companies are interested by the development of this axis and did research on time sensibility.

In fact, they look to check frequently business process temporal properties, which are not sufficient in BPMN. At the same time, it's not easy to model temporal constraints in BPMN. For that, it is always possible to find practical solutions to get out of it, as BPM tools and some frameworks...

In addition, real time processes are processes which have real time characteristics. Although, our real time definition takes the meaning from real life customer needs. We tried to find a definition that can be adaptable to all domains especially business and management domain. While in dictionary and system domain, the definition of real time is right now, but in real life, it depends on customer needs, in other words, we try to give a flexible attribute to time, and customer needs will be our constraints.

Theoretically and systematically, real time enterprises are enterprises that would react instantly to their business needs, practically this is not possible, and we are rather near real time. Consequently, our new concept of real time will be right-real-time/right-time. This new concept is based on time latency, which depends on business users and technologies used.

In this paper we will show a formal definition of the real-time concept, real-time ontology, different attributes of this concept, and we will propose an additional real-time component for BPMN, that was applied to Novel Coronavirus (2019-nCoV) management process, as case study.

II. BASIC CONCEPTS OF REAL-TIME

A. Real-time process

The traditional definition of a process is a set of steps letting to achieve certain results. According to each domain, we can have a specific definition of a process. In the industrial frame for example, a process is a set of steps for products manufacturing. In many enterprises and companies, a process is more complicated than this simple definition considered as an elementary one. A process can be also a set of process called sub-process. To model processes, companies choose between many languages that facilitate drawing, reading and executing these processes according to many constraints, as BPMN language.

Real-time processes are processes which have real-time characteristics. However, real time processes are processes which have real time characteristics. Although, our real time definition takes the meaning from real life customer needs. We tried to find a definition that can be adaptable to all domains especially business and management domain. While in dictionary and system domain, the definition of real time is right now, but in real life, it depends to customer needs, in other words, we try to give a flexible attribute to time, and customer needs will be our constraints. So, a real-time process is a process that is able to accomplish a service and to satisfy the client.

B. Real-time enterprises/organisations

Real time enterprises are characterized by real time processes usually automated according to established business rules in addition to some appropriate technological solutions. Real time processing in real time enterprises can be as tasks processing, management capability processing, data flow processing and predictive analysis processing... this real time processing has a great impact as long term changes in technologies deployed by the enterprise, process management and other ...

So, we can define a real time company formally as:

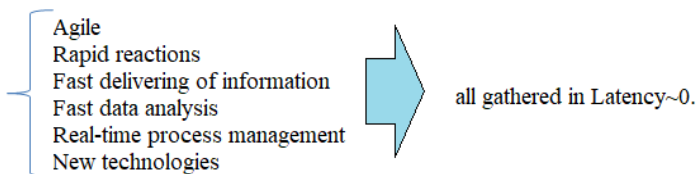


Figure 1: formal definition of real time company

III. RELATED WORKS

Time is subject of research for a long time, which will never die as long as humanity exists. Time first of all is a philosophy term that has many definitions according to all philosophies and scientists, but they all agree about the fact that time is continuous and has an intrinsic order, in other words,

events are in progress from past to present then to future. These three categories of time will let us to think more about having a simple classification of time: periods, seconds, minutes, hours, days, months and years... that will give us time ontology:

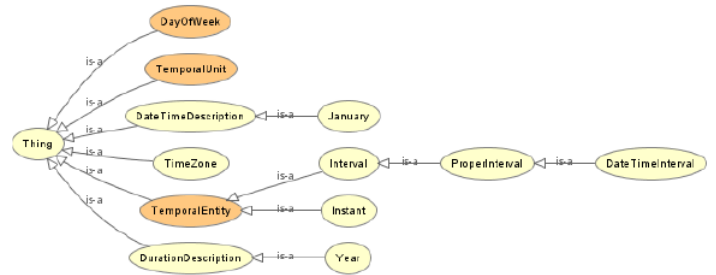


Figure 2: Basic time ontology [7]

Researches are interested by time subject for long time ago; however, there are no many research works on the analysis of time issues, especially real-time process. Jahanianl et al.[4] present the formal syntax and semantics of real-time logic, that is a logic for the specification of real-time systems.

In other hand, David et al.[5] present a framework for formal verification of a real-time extension of UML statecharts.

However, Dobrev et al.[6] proposed a real-time BI (RTBI) systems, that can offer significant and measurable improvements, help organizations remain competitive, and in the long run, drive strategic business objectives from a grass roots level.

IV. REAL-TIME FORMAL DEFINITION

A. Real-time ontology

The first step was to find the formal definition of real-time concept. Although, our real time definition takes the meaning from real life customer needs. We tried to find a definition that can be adaptable to all domains especially business and management domain. While in dictionary and system domain, the definition of real time is right now, but in real life, it depends to customer needs, in other words, we try to give a flexible attribute to time, and customer needs will be our constraints.

Theoretically and systematically, real time enterprises are enterprises that would react instantly to their business needs, practically this is not possible, and we are rather near real time. Consequently, our new concept of real time will be right-real-time/right-time: right information, right person, and right time.

According to the methodology proposed by A. Ouarhim et al. [1], there is a need of an acceptance interval and a theoretical-time when we face time in a real-time process. The acceptance interval can be defined as customer satisfaction interval, and the theoretical-time is the ideal time that should be predicted, by using the different tools of prediction.

So, according to these results we can define real-time formally as:

$$\text{Real-time ontology} = \text{Time ontology} + \begin{cases} \text{Latency} \\ \text{Acceptance interval} \\ \text{Theoretical time} \end{cases}$$

The figure bellow shows the adapted version of the ontology of time; proposed by M. Kirikova et al.[7]; including real-time concept:

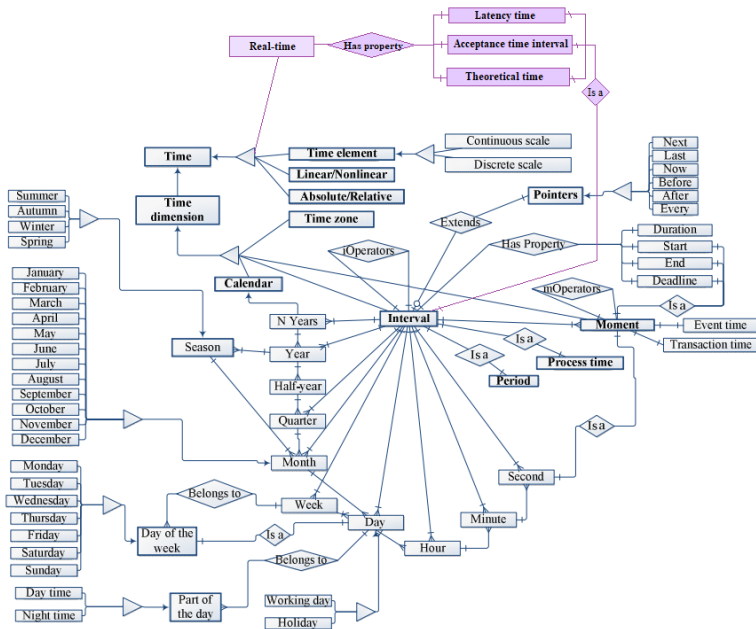


Figure 3: Time ontology (adapted with real-time ontology)

This adapted version adds a new dimension of time to time ontology, which is real-time. This new dimension contains three components: latency time, acceptance interval and theoretical time. This definition gives a new vision of time, not just an ordinary vision as periods and calendar but as a response to our needs in real-time enterprises: real-time.

Latency is the first attribute in this definition, as we had already mentioned, real-time is not attainable in his full meaning, so time latency is reliable to the definition of real-time. It can be defined as an interval. Our definition of real-time is related to client need, for that, it was necessary to define an new attribute which will frame us in a safe interval of latency, so we had defined the second attribute acceptance time interval. Acceptance interval is defined as interval too, it represent the interval of safety, in which latency will not affect the flow of the process. Theoretical time is our projection in future of our results. The goal of defining this theoretical time

is our need to compare results, to identify how much we are far from the ideal result In general, theoretical time is considered as an ideal result, and the upper bound of acceptance interval as the worst result, so the lower bound will be theoretical time.

B. Time in a business process

In a business process, time takes different forms, but there is no definition of real-time concept. Figure bellow shows figures of time in a business process:

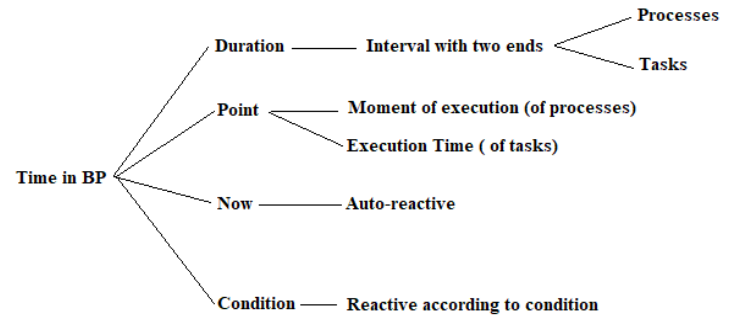


Figure 4: Time in business process

V. ADDITIONAL REAL-TIME COMPONENT: BPMN

We are interested by components that have relation with time, so after a large analyze of BPMN specification we found that Event is our interest. The figure bellow, figure 5, is a metamodel diagram with our interested components.

Event has a direct relation with FlowNode but indirect relation with activity through boundryEvent and specialy catchEvent. Event and Activity inherit from FlowNode, which inherit from flowElement. The component Process inherit from FlowElementContainer which is a composition of FlowElements. So as we see, and as the definition of time in a process shows, activity is more concern by time and by real-time, and the whole process too.

We propose to create a new component Real-timeAttribute as follow, figure 5, (OMG specification diagram [8]: adapted version):

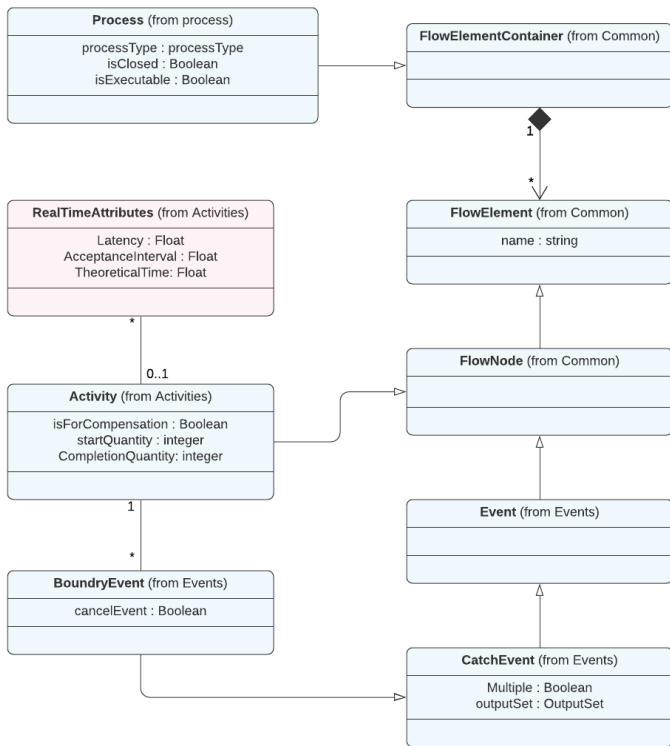


Figure 5: new real-time component with additive attributes(adapted version)

Figure 5 presents important components concern our research, plus, our new component real-time attributes, which contains three attributes: latency, acceptanceInterval and theoreticalTime.

This component will let us to have more information and control into our real-time processes. This definition will give us another vision of processes, and a more clear vision to what is a real-time process.

The figures bellow represent prototype of the extending component:

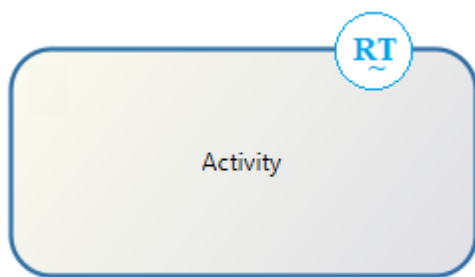


Figure 6: prototype extending Activity component (real-time Activity)

VI. APPLICATION TO NOVEL CORONAVIRUS (COVID-2019) MANAGEMENT PROCESS

Novel coronavirus has been identified for the first time in Hubei province in Wuhan China. The centers of disease control

and prevention try to monitor different assumptions which this virus caused especially outbreaks of respiratory illness.

Coronaviruses are a large family of viruses common to many species of animals, including bats, cats, cattle, and camels. Infrequently, animal coronaviruses can be infected and spread to people like MERS, SARS, and this one Coronavirus[9].

Chinese health officials have reported tens of thousands of Coronavirus infections in China. Many of the Coronavirus infections associated with travel from Wuhan, are also reported in a growing number of global destinations, including the United States. This affliction is often reported to be from person to person. The spread of the virus was found outside of China too. The United States reported the first confirmed example of a person to person transmission of the virus on January 30, 2020[9].

We choose BPMN as language for our study. The figure bellow, figure 7, shows the general process of Assess 2019 Novel Coronavirus. It contains three sub processes: Identify, Isolate and intensive care. We are interested about this two sub processes: Identify and Isolate as real-time processes, or in other words as a risky processes for patient safety and others in his entourage.

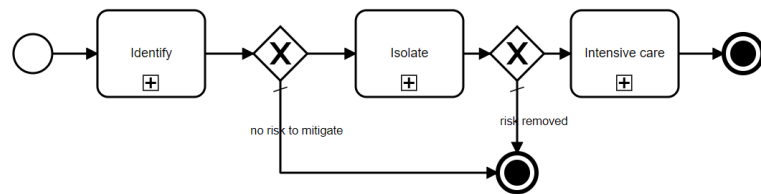


Figure 7: The general process of Assess 2019 Novel Coronavirus

Figure 8 is the identifying process, which allows the evaluation of patients who may be ill with or who may have been exposed to 2019 Novel Coronavirus 2019-nCoV. The first step was “fulfill personal information”, before responding to many important questions: Identify if in the past 14 days since first start of symptoms a history of either travel to china or close contact with a person known to have 2019-nCoV illness?, have a close contact with a laboratory confirmed 2019-nCov case? And if the case spend time in Wuhan or Hubei city he/she will go directly to isolation. For example, the case founded in morocco went directly to isolation system by responding to the first question that is: spend time in Wuhan a Chines city, which is the source of CoronaVirus. By responding to these questions we can have a decision according to results, so we can end the process directly (no risk to mitigate) or we must to do another test that is: The person has fever or symptoms of lower respiratory illness (e.g., cough or shortness of breath)? . If there is symptoms the patient will be isolated and redirected to isolate process, else, he/she will discharge to home, however the process will redirected to discharge to home process.

This “identify” process is sensible to time especially in the case when the person ill with CoronaVirus 2019-nCoV.

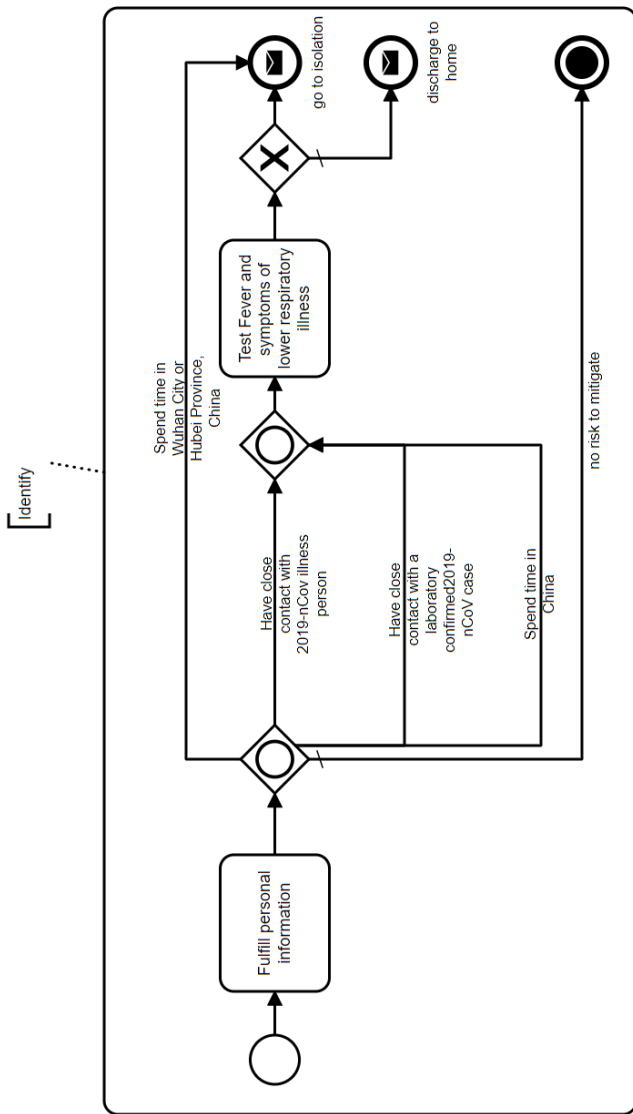


Figure 8: Process to Identify 2019 Novel Coronavirus

The figure below, figure 9, represents “Isolate and assess process”, the role of this process is to assess the status of the patient, by responding many important questions, and doing some important cares.

The process begin by catching one of these two messages: go to isolation or discharge to home. Concerning isolation part, there is many steps must be done: isolate the patient in a private or a separate area, place facemask on patient and wear suitable personal protective equipment (PPE). Assess clinical status must be done to the patient to evaluate his/her situation: Is fever present? Measured? Is respiratory illness present? Cough? Shortness of breath?. After, health department must be informed about the results to report at-risk patients and their clinical status. Assess need to collect specimens to test for 2019-nCoV, to be able to decide disposition to go to have a deep treatment/intensive care, discharge to home or in case of risk removed the process ends.

The patient can also be discharged to home, in this case there is a special cares to do, and the patient must be instructed as needed based on the intensity of the illness and health department consultation: Home care and isolation guidance. It should also advise the patient if he or she develops a new or severe fever or respiratory illness, and call the clinic to determine if a re-examination is necessary, and if a re-examination is required, he or she should call in person and wear a face mask. . The patient will go to assess clinical status. In the case of re-examination not required the risk removed and the process is terminated.

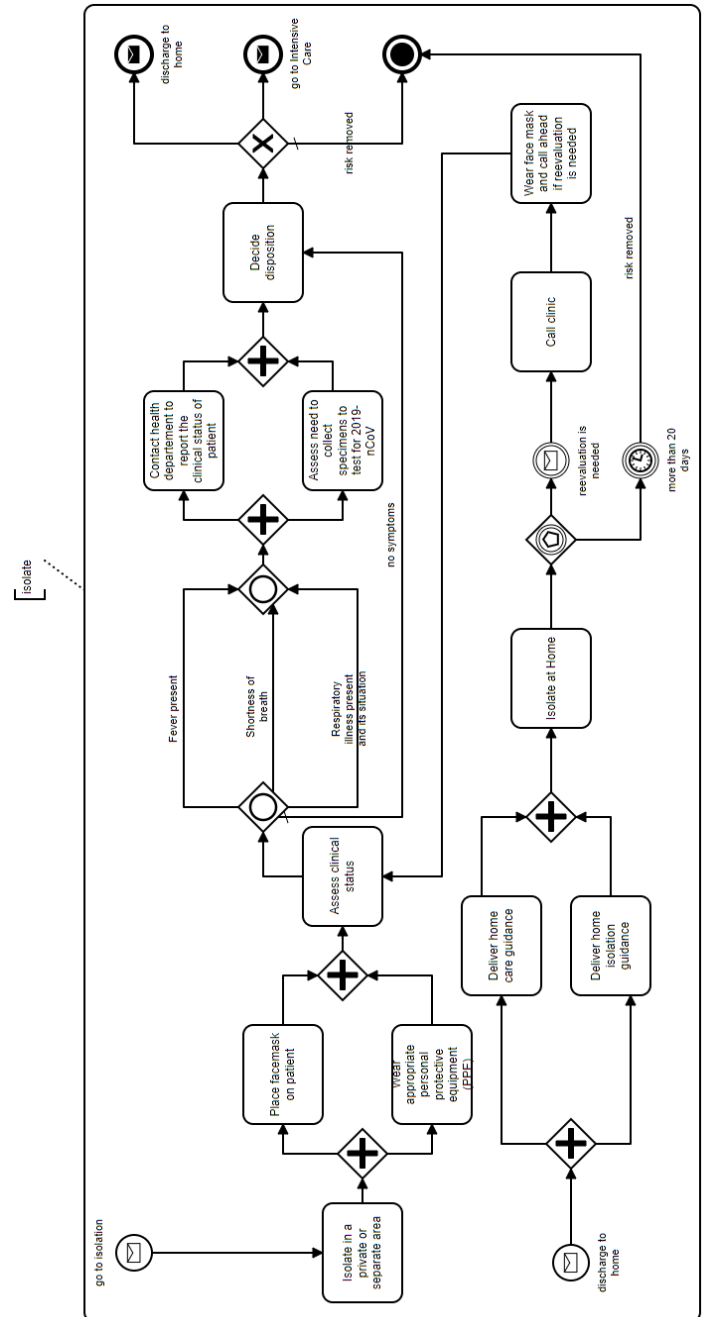


Figure 9: Process to isolate and Assess 2019 Novel Coronavirus

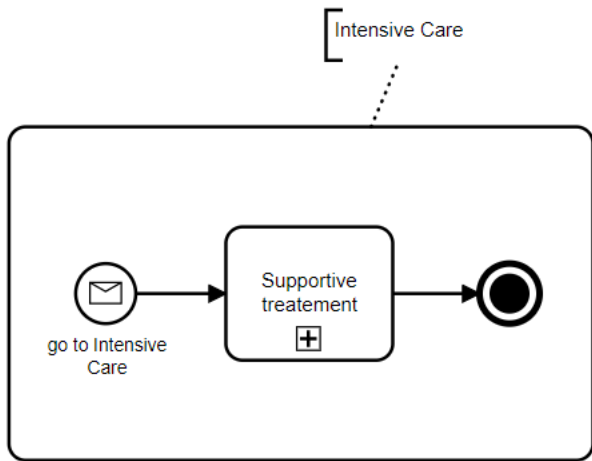


Figure 10: Intensive care process

Figure 10 represents the intensive care process. Actually, there is no exact treatment for this 2019-nCov, many treatment interact for healing. The process shows a received message from isolation process “go to intensive care”.

We applied our proposition to Coronavirus process. The idea is to have a clear idea about the development of time during the process. Real-time concept is always needed in cases when we have a maximum risk. For that we present new version of previews processes, with real-time component.

Figure 11 present identify process. Fulfilling patient information must not take much time, so there is a need of real-time component. Test fever and symptoms of lower respiration illness must be done on time without a large time latency, for patients’ safety. So real-time component is needed here too, to have a clear idea about the progress of our process. And finally another one in the sub process, as activity type, we need to take information time about the whole process.

The same thing with isolate process, figure 12, we put real-time component on activities where we have a maximum risk, for more precision concerning time latency on activities, to minimize the risk. As: isolate in a private or separate area, we must isolate the patient immediately. The same thing with assess clinical status and Decide disposition, to know patient status quickly, before contacting health department to report the clinical status of patient to assess, which needs to collect specimens for tests (2019-nCov), which must be on real-time.

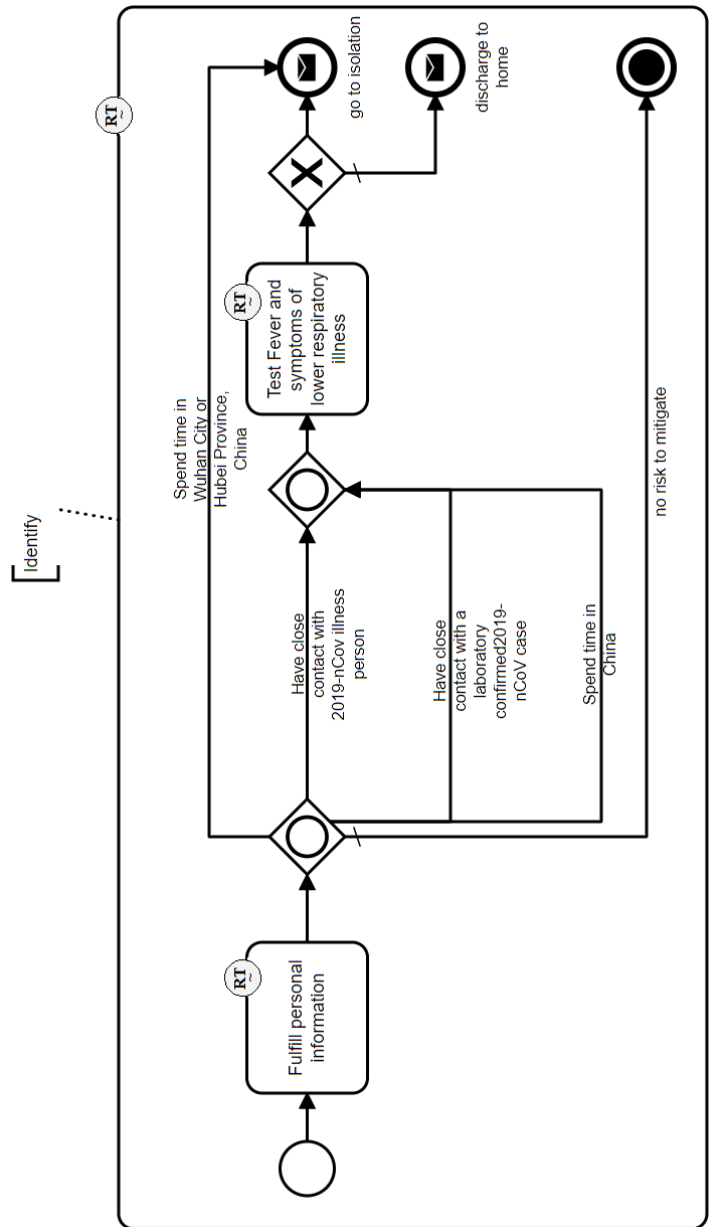


Figure 11: Identify process with real-time component

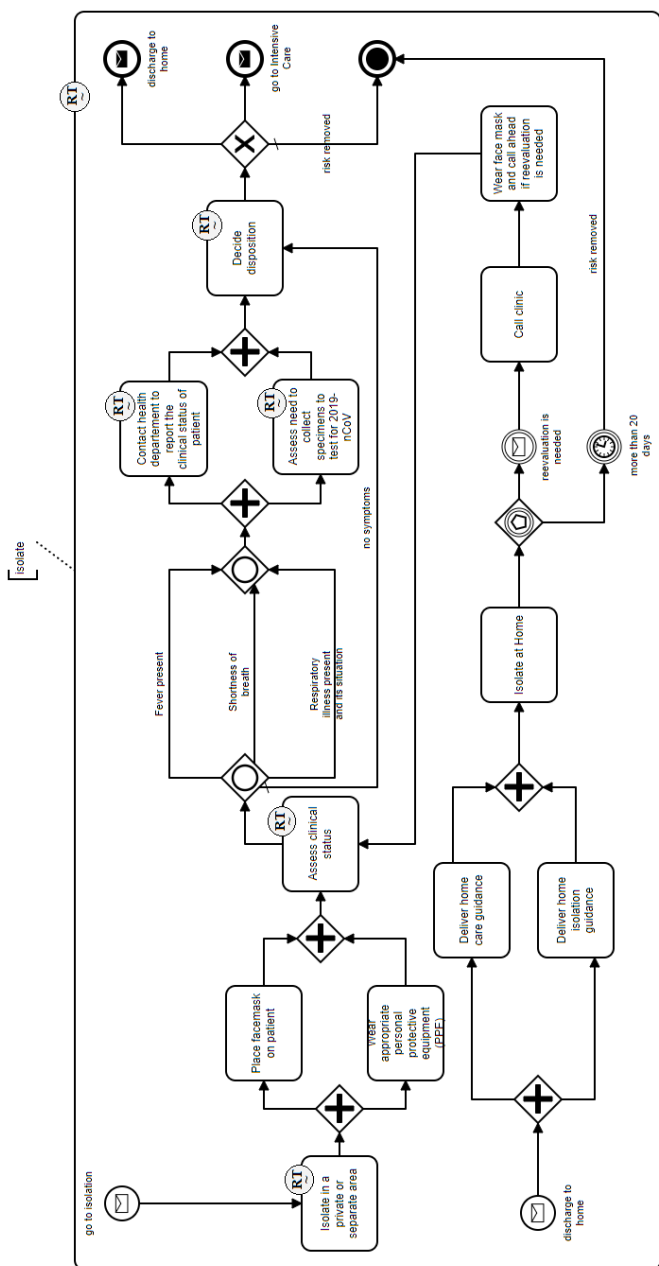


Figure 12: Isolate process with real-time component

VII. CONCLUSION

This work presents a formal definition of real/right time concept, real/right time ontology and a proposition of a real/right time component with real/right time attributes. This new dimension of time contains three components: latency time, acceptance interval and theoretical time. This definition

gives a new vision of time, not just an ordinary vision as periods and calendar but as a response to our needs in real-time enterprises: real-time. This definition will facilitate the interaction and the use of real-time concepts; do the different studies needed to improve the different domains, real-time domain. The proposition of a real-time component for BPMN language is a way to identify and define real-time processes, and a way to control and to monitor real-time processes, that was applicative to Novel Coronavirus (COVID-2019) management process, as case study.

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