Failures of a Business Process in Enterprise Systems

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Abstract. A business process model typically describes a desired flow of events in an ideal environment. However, the reality tends to be more complicated than what is designed in the model. During the execution of business process instances, a lot of exceptions may occur. These exceptions are deviations from the correct, specified sequence of events. Thus it is important to know the behaviours of process instances in the presence of exceptions. The classical approach of incorporating exception analysis in process models has been trying to anticipate beforehand all possible exceptional conditions that might arise and argue the process model with those additional conditions in order to determine the exception handling actions. This approach, however, might be problematic because the identification of all possible exceptions relies on the experience and intuition of the participants.To have a clear understand of the failure behaviour of a business process is equal important, but first of all, it has to be studied what characteristics of failure often have. In this paper, we present the initial findings of our project that targets to the enterprise issues of healthcare systems.

Keywords: Failure, Failure characteristics, Business process.

1 Introduction

An enterprise system is an information system that promises a seamless integration of all the information flowing through an organisation.It provides a technical platform that enablesorganisations to integrate and coordinate their business processes. The concept and adoption of enterprise systems have attracted increasing interests as organisations have been seeking how they do their business more efficiently. In the approach of adopting an enterprise system, business processes become a dominant factor because that without having a clear understanding of those business processes, the dream of integration proposed by the enterprise system will quickly turn into a nightmare.

In order to understand them, business processes have been analysed for various purposes, for example validation, verification and performance evaluation. During the analysis, the properties of a business process, for instance correctness, effectiveness, and efficiency, can be modelled and checked by formal or informal methods. Usually, some exceptional mechanisms are designed to handle the known errors that may occur in the execution of business processes. However, the reality tends to be more complicated than what is designed in the model. During the enactment of a business process a lot of failures might occur. To assure that a business process is still able to

M.M. Cruz-Cunha et al. (Eds.): CENTERIS 2011, Part I, CCIS 219, pp. 139–146, 2011.

fulfil its organisational goals, it is of equal interest to know the behaviours of a business process in the presence of failures.

This paper will present our research onstudying the characteristics of the failure occurred in the business process. The purpose of this research is to provide a comprehensive view of the failure so that the business process analysis in terms of failure behaviour can be easily and systematically done. The paper is structured into 6 sections: Section 1 is the part to briefly introduce the research; Section 2 distinguishes some important terms used in our research, and explains the focus of our research at the same time; Section 3 describes the method of our research; and Section 4 is the main part of this paper, it shows the initial findings of our research; Section 5 discusses some other characteristics of a business process failure; Section 6 concludes the findings and indicates the future research works.

2 Background and Definitions

The concept and issues about failure have been studied in many domains. In this section, we filtered the information for the purpose of studying business processes, and gave the definitions of several terms used in our research.

A business process, by its definition in [OMG/BPDM], is a collection of related, andstructured *activities*. The specification of a process defines the set of activities as well as the procedure and conditions on when such activities will be performed, i.e. in what order an activity is executed and how. A business process might have a hierarchical structure, therefore it can be defined as: a business process is composed of a set of activities linked together in order to interact, where each activity is another process, etc.; The recursion stops when an activity is considered to be atomic: any further internal structure cannot be discerned, or is not of interest and can be ignored.Although there is a difference between the terms of *process* and *activity* in terms of internal structure, we use them analogically.

The *function* of such a business process is what the process is intended to do and is always described by its requirements in terms of functionality and performance. On the other hand, the *service* of a business process is what the process behaves to implement its *function*.

A *correct service* is delivered when the service implements the process function. And a**service failure**, often abbreviated to **failure**, is an event that occurs when the delivered service deviates from correct service. The deviation from correct service may assume different forms that are called service **failure modes** and are usually ranked according to **failure severities**.

In short, **failure** is a term to describe the state or the condition of a processin which the process does not satisfy thedesirable or intended objectives. A **failure** is usually viewed as the opposite of **correctness**.

As in definition, failure is a state deviated from a correct state. In the domain of business management, there is another term *exception* that is also defined as a deviation from desired sequence of events. The concept of a failure and an exception are treated differently in our research. Basically, an exception is a deviation of the sequence of the activities in the process, and a failure refers to a deviation of the state of the activities. An exception is always an issue related to the structural model of a

business process, but a failure is a run-time behaviour of a process. For example, in a business process management system of car insurance, the process of an insurance claim may have several exceptional routes to handle the unusual cases. However, in a real instance of insurance claim, the case at any stage in the process may have errors, for example, the incorrect description of the accident or over-estimated damage of the accident. All those errors may cause the outcomes of the activity fail to achieve its designed function, so it is a failure. But the case may be processed following the normal procedure because the fault in the outcomes of the activity is not identified.

A business process management system is cased-based, i.e., every activity is executed for a specific case. The goal of a business process management system is to handle cases as efficiently and effectively as possible. The business process model is designed to handle similar cases. A part of common cases may have additional conditions, and they are modelled as exceptions. From that point of view, failures are not exceptions that are not foreseen during the design of the process model and not captured during the execution of business process instances. Therefore, the study of business process failures that will increase the awareness of failures in process engineers' head is a vital factor to improve the overall quality of business process management system. In next section, we will firstly introduce the method of our research.

3 Research Method

The research was seeking a comprehensive view of business process failures so that the failures can be handled by exceptional routes in the business process model. In terms of identification, the methods to identify exceptions or identify failures are same. So in the research, on one hand, we reviewed the methods of exceptions identification, especially various classifications of business process failures, for example [1,3-15]; on the other hand, we also gathered the published analysis results of the business failures, for example [16-25]. In this paper, we discussed the initial findings from our literature review.

4 Dimensions of Failure

In the research, we found that same as quality of business process, a failure of a business process has also several dimensions. In this section, we discuss these dimensions in details with examples. The discussion is based on one of our case studies, a business process of stroke care in secondary care. Figure 1 shows the diagram of the partial process which can also be viewed at NHS map of medicine (http://eng.mapofmedicine.com/evidence/map/stroke_and_transient_ischaemic_attack_tia_2.html). A set of brief descriptions of each activity are also published on the website. In this paper, we do not explain the process in many details, but basically it is a clinic treatment process, started from a suspect stroke patient receiving normal clinical representation, and ended with the patient admitted to stork unit.

In the process, failures might occur at every activity due to the reasons related to the activity itself, issues related to the resources or human errors. In spite of the sources of a failure, we also find that a failure may fall into one of following categories:

- Incomplete, the activity does not fully perform its function.
- Invalid, the correct service does not last for a right period of time.
- Inconsistent, the activity cannot perform consistently.
- Timely, the activity is not enacted on time.
- Inaccurate, the activity is not enacted for the right purpose.

In following, we will explain them in details.

Incomplete – For example in Figure 1, the activity 13 is to carry out a blood test. In the specification, there will be 5 blood tests: 1) blood glucose level - exclude hypoglycaemia as the cause of sudden-onset neurological symptoms; 2) full blood count (FBC); 3) urea, electrolytes, and creatinine. There are also some tests to consider, including a) coagulation profile, especially if considering thrombolysis or if haemorrhagic stroke is suspected; b) erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP); c) lipid profile; and d) troponin, if ECG is abnormal or history of chest pain. For those tests, the result of test would be important evidences. However, if there are some tests missed, especially the three basic tests, it will be an incomplete failure.

Invalid – Taking the same activity as an example, when the blood tests should be done, it requires the relevant resources are available for a period of time, for example 1 hour. That means in this 1 hour, the resources to perform the blood test, including human resources, equipment, test material, etc., should be ready. If not, it is an **invalid** failure at this activity.

Inconsistent – In a hospital, most of test can be analysed by machine and today's technology can provide a satisfied consistency. However, some examinations or tests are still only by human, for example the brain image (activity 14). The outcomes of this activity need a curtain consistency in order to improve the quality of care. The **inconsistent** failure might occur at this activity because of the experience of brain image examiner.

Timeliness – Timeliness failure usually refers to early or late failure, which means the outcomes of an activity are either too early or too late. For example the activity 16 --- reviewing investigation results, the doctors diagnose the type of stroke which the patient may suffer and then send the patient to relevant unit to have a right treatment. However, the diagnosis may take longer for some reason, so that the patient may miss the best time to have a treatment. That will be **timeliness** failure.

Inaccurate – Inaccurate failure usually means that the activity is enacted for a wrong purpose, or the value of the outcomes is wrong. For example, the blood test, the results of blood tests may be inaccurate because the sample may be contaminated. The inaccurate failure is one of common types of failures.

5 Other Characteristics of Failure

During our research, we also find that in some cases there are some other characteristics of failure need to be modelled in the business process. For example, considering a failure tolerant business process, the degree of failure deviation may be needed. In another case, considering timing sequence, the time parameters of service validation are requested.

In summary, a failure can be modelled as a tuple (*mode*, *degree*, *timing*), in which the *mode* is failure mode which can be in one of dimensions listed above; *degree* is an estimation of the degree of deviation; and the *timing* is the valid time period of the failure. In a business process model, especially when analysing failures, degree and timing characteristics are optional. But for the case of performance evaluation of a business process, the value of timing parameter of a failure is usually available.

In a complex case study, it can be easily too big to model all possible failures in a graphic model. Therefore, we can store all information of failures in a business process in XML files, and manage the files in a native XML database. We define an XML Document Type Definition (DTD) to do that.

```
<?xml version= 1.0?><!ELEMENT Task (ID, Name,
Brief,Activity+, Resource+, Constraint+)>

<!ELEMENT ID (#PCDATA)><!ELEMENT Name (#PCDATA)>
<!ELEMENT Brief (#PCDATA)><!ELEMENT Activity
 (ElementID, ElementName,ElementBrief, FailureMode,
Category )>


<!ELEMENTResource (ElementID,ElementName,
ElementBrief,FailureMode,Category)>


<!ELEMENT Constraint (ElementID, ElementName,
ElementBrief,FailureMode,Category)>


<!ELEMENTElementID (#PCDATA)>

<!ELEMENTElementName (#PCDATA)>
```

6 Discussion

The evaluation of our research is a long process that depends on a large amount of applications. It also depends on the method and tool that how to analyse the failures in a business process. These two parts are highly coupled. From a process point of view, the evaluation of our approach is an iterative process: applying approach to new case studies; getting experience of using the classification we proposed in this paper to identify possible failures; and finally evaluate the approach.

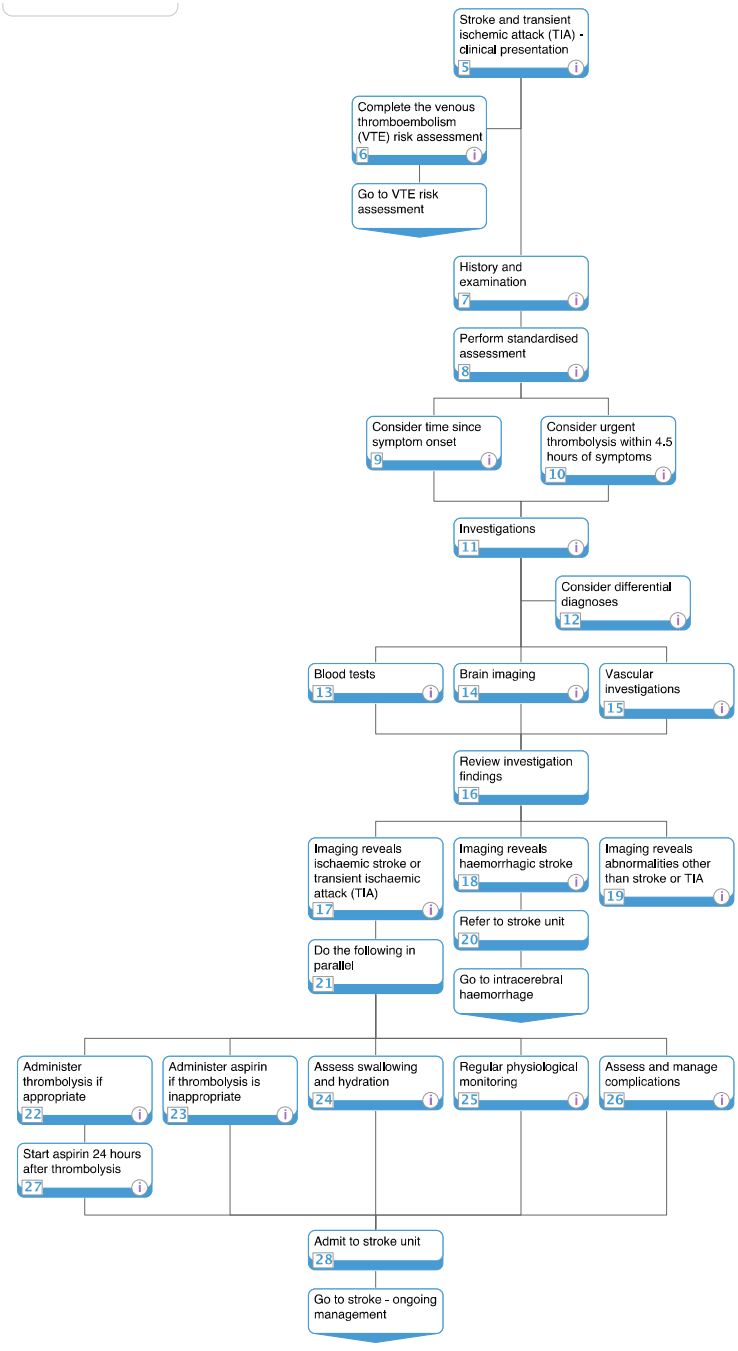

Fig. 1. Pathway of Stroke and Transient ischaemic attack (TIA) Patients in secondary care [2]

In our research, we also identified there are several points to be improved in the near future. One of them is the language of modelling failure. There are many complex scenarios in the real case studies. However we only construct a simple structure of failures and their relationships.

7 Conclusion

We have described our initial findings of studying failures in business processes, particular the processes in healthcare organisations.These findings can be a starting point of set up a failure repository for the next step of our research. Because our project is still at early stage, it is difficult to validate the research with limited case studies. The next step of our research will be more case studies to strengthen the knowledge of business process failures. We aim to have a comprehensive knowledge database to help the reform the business process in healthcare organisations.

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