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A METHOD FOR DERIVING SYSTEM MODELS BASED ON BUSINESS PROCESS MODELS

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ABSTRACT

This paper presents a new method for deriving system models based on business process models. The congruence between the central notion of 'automated activity' in improved RAD model and that of 'process' in DFD facilitates the deriving process. This method led to develop system models in early stage which can be used to perform what-if analysis to define the applicability and profitability of the anticipated software system. The process of cancer registration in Jordan is used to demonstrate the proposed approach and showing its ease and timeliness. Finally, further work is planned to validate and evaluate the proposed method using several cases with different domains.

Keywords: Business Process Modeling, System Modeling, Role Activity Diagramming, System Requirements.

INTRODUCTION

Many modern organisations have large and complex processes which include individuals, groups, information technology, and a web of complex interactions among individuals, organisation, and technology. Customers expect high quality products and services while organisations face rapid changes in the business environment. Therefore, organisations need methods to support their activities, functions, and interactions in order to meet customers' expectations. Moreover, Shin and Jemella [12] indicate that "information technology has profoundly changed the way we do business during the past decade". Therefore, organisations need to manage these technological changes and identify methods which will help them to perform these changes efficiently, effectively and in the most suitable way. One method to support an organization is by automating its business processes using software system. Unfortunately, developing software system is sometimes difficult and expensive process as it needs to go through system development life cycle. So, it is important to make sure that the anticipated software system is economically feasible and support business processes of such organization effectively and sufficiently otherwise, the software system will fail.

Process modelling can be used to provide a comprehensive understanding of business activities and functions and thence a base for detailed process analysis. Saven [11] stated that business process modelling is becoming increasingly popular as it facilitates a common understanding and analysis of business processes in an

enterprise. She added that process modelling can be used to learn about a process, or make decisions about a process, or develop business process software. Also, business process modelling can be used to contribute positively in the software development process. Tam et al. [13] argued that BPM aims to identify critical processes, improve the overall performance of the business, form a tool for business process re-engineering, identify appropriate strategies for software package implementation, and help with software development. Phalp [10] pointed out that business process modelling techniques can be used for traditional software development as well as to facilitate business processes improvement or restructuring. There is scope for expanding consideration of the role of IT in enhancing the business process. Bridging the gap between business process models and system models is important for the different stakeholders involved, so as to ensure that an anticipated software system will be in line with the business processes. However, the gap may be further widened given the rate at which software technology develops, for example with the emergence of grid technology in business environments. Therefore, the challenge here is to investigate and synthesise approaches that will in some way support, and perhaps partially or fully automate the business process so that the process is not simply modelled but also *enacted*, through an IT-based solution.

Few approaches have been developed in order to link between business process model and system models. For example, Dijkman and Joosten [4] introduced a technique to simplify requirements capture. The technique can be used to derive functional requirements, specified in the form of UML use case diagrams, from existing business process models. In 2003, Odeh and Kamm [8] proposed a method to explore relationship between business process model and use case model. Their method has led for the derivation of use case system model from a process model particularly Role Activity Diagram (RAD). Although they managed to develop use cases from transactions and states derived from RAD models, some difficulties in deriving system actors were highlighted. This was attributed to the unavailability of simple mapping of roles in process models onto actors in use case diagrams. Issa and Aburub [5] developed structured approach to perform feasibility study using process models represented using RAD. This approach is based on the derivation of number of use cases from RAD models and then utilizing this information to estimate total effort leading naturally to project feasibility analysis. Chun et al [3] proposes a translation technique that emphasizes the generation of readable (block-structured) BPEL code from BPMN model. While these methods can help to derive system models from business process models, they still suffer from some shortcomings. For instance, there is no structure steps lead to the derivation of system models from business process models.

This paper aims to propose a structured method that derives software system models based on business process models. This led to identify software system appropriate for business processes in early stage which then can be used to perform what-if analysis to define the applicability and profitability of the anticipated software system. Business process models and system models are presented in the next section followed by a method for deriving system models based on business process model. Finally, the conclusion and future work are introduced in the section 4.

BUSINESS PROCESS MODELS AND SYSTEM MODELS

Role Activity Diagramming [9] is the process modelling language that is adopted in this research. Role Activity Diagrams (RADs) are diagrammatic notations to represent and model coordinated behaviour and interactions within a process. According to Ould [9], RAD represents the roles that perform a part in a process, and their elements (activities and interactions). RAD presents the task(s) of roles in the process and how they collaborate. Because RAD adopts the role as the primary unit for analysis in process models, it is suitable for organisational contexts, since it partitions the organisational behaviour of a process into roles [9]. A role involves a sequence of activities, which are carried out together as a particular responsibility. According to Saven [11], roles can be identified as abstract notations of behaviour representing a desired behaviour within the organisation. They can include software systems, customers and suppliers. RADs provide a visual representation of the different aspects of a process, which makes them useful in supporting communication, since they are easy to read and understand. RADs can also be used to demonstrate how processes interact [11].

In a RAD, a role involves a sequence of activities which are carried out together within a particular responsibility. Roles are abstract notations of behaviour describing a desired behaviour within the organisation. They can also include software systems, customers and suppliers. Each role is represented in a RAD as a named bounded area containing activities, interactions, and logical elements. Activities are represented as black boxes. Figure 3 shows an example. Vertical lines linking activities and interactions within a role represent states of the role. Concurrent activities in a role can be represented using up-pointing triangles, and alternative activities shown using

down-pointing triangles. Interactions are represented by horizontal lines linking boxes in different roles; a shaded box shows where the interaction is initiated, and a white box shows the receiving end. The main RAD notation is shown in Figure 1.

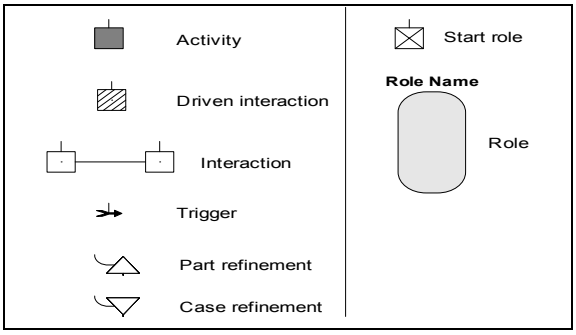

Figure 1: Part of RAD notations

The advantage of the RAD modelling language for the present research lies in the relative ease of understanding of the diagrams produced, and the clear identification in the RAD models of the main roles (responsibilities), activities, decision points, and relationships in a business process. Data flow diagramming (DFD) is a system model that has been adopted in this research. DFD is a method to represent the flow of data or information within processes. DFDs can be used to represent an in formational view of business process, since they show how processes interact with each other (and with users and external processes) through the flow of information. DFDs are easy to understand, draw and amend. Each process can be divided into sub-processes at a lower level to show more detail [11]. The main DFD notation is shown in Figure 2. Data flow diagrams also show a functional view of business processes, since they show functional dependencies, and what activities change the information.

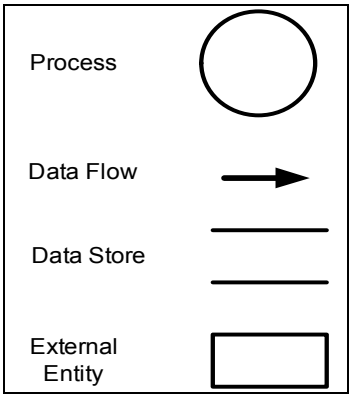

Figure 2: DFD notations

A METHOD FOR DERIVING SYSTEM MODELS FROM BUSINESS PROCESS MODEL

Most organizations developed process models for their business processes for many reasons such as applying TQM. This method utilized business process models to derive system models in order to be fitted and in line with the business processes. We propose a five-step method:

1. Developing a Business Process Model Using RAD
2. Identify Automated Activities
3. Discover Initial Functional System Requirements
4. Functional Specifications Document
5. Develop DFD Based on Functional Requirements Document

Develop a Business Process Model using RAD

This step aims to understand business process of such an organization and model the business process using RAD. RAD models show how a certain process can be carried out to achieve an organisation's goals by illustrating work flows, roles of employees, interactions between the roles, and information flow from one role to another and from one process to another. Figure 3 shows RAD model of cancer registration process (CR) in Jordan. Cancer registration is part of a wider process of cancer care. The cancer registration process in Jordan is managed by the Jordan Cancer Registry (JCR) which tracks malignant and some benign cancer cases [1]. The main objective of the process of CR is to improve the administration of cancer treatment and the collection of information about can-

cer cases, which should contribute in the longer term to better understanding of cancer and a reduction in the impact of the disease. Observation and interviewing were the main techniques used to understand and model the CR process in Jordan, as part of a wider modelling of cancer care and registration which focused on activities and interactions within hospitals. CR is chosen here a smaller, self-contained subprocess which provides sufficient illustration for the purposes of the present paper.

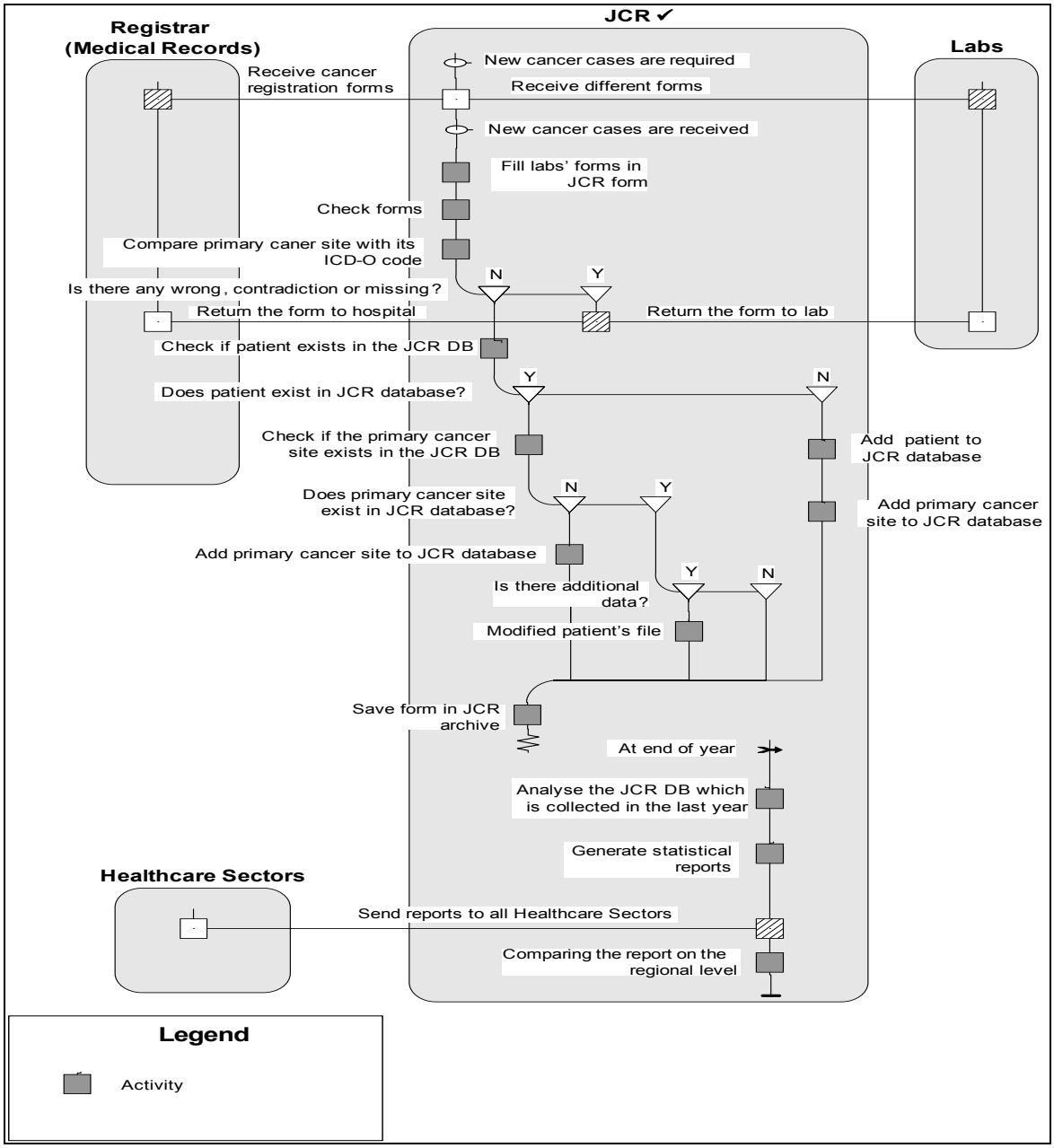

Figure 3: RAD model of Cancer Registration Process

Identify Automated Activities

Activities can be classified into automated activities which are performed using a computer-based system and non-automate activities which are performed without using a computer system. When the business process is designed and modelled, automated activities should be identified and modelled. Aburub et al. [2] introduced an improved RAD model in order to identify automated activities. Figure 4 shows the improved RAD model of the cancer registration process with bold boxes to represent automated activities and regular boxes to represent non-automated ones. Moreover, bold lines could be used to represent automated interactions (interactions performed using a computer system), and regular lines to represent non-automated interactions (interactions performed without using a computer system). Determination of automated activities will be used to develop software more fitted for business process as automated activities represent activities that need to be supported by software.

Discovering Initial Functional System Requirements

According to Kotonya and Summerville [7], system requirement is "a statement of a system service or constraint". Moreover, functional requirement defines a function of a software system or its components. Therefore, functional requirements can be thought of activities that we need to be achieved using computer system. Functional requirements can be initially synthesized using improved RAD model by checking each activity and list all automated activities in the model. These activities represent what we need to be performed using computer system. Based on the Figure 4, the automated activities of CR process (functional requirements) are:

1. Check forms
2. Check primary cancer site with its ICD-O code
3. Check if the patient exists in the JCR Patient DB
4. Add new cancer patient
5. Check if the primary cancer site exists in the JCR Cancer DB
6. Add new primary cancer site
7. Modified patient's file
8. Analyze JCR DB
9. Generate statistical report

Create Functional Specifications Document

Functional specifications document describes how each automated activity should be performed. Functional specifications document may include: description of data to be entered into the system, description of workflows performed by the system, description of system reports or other outputs, and who can enter the data. Furthermore, the functional specifications document is designed to be read by a general audience. Readers should understand the system, but no particular technical knowledge should be required to understand the document. Table 1 shows a brief functional specifications document of CR process.

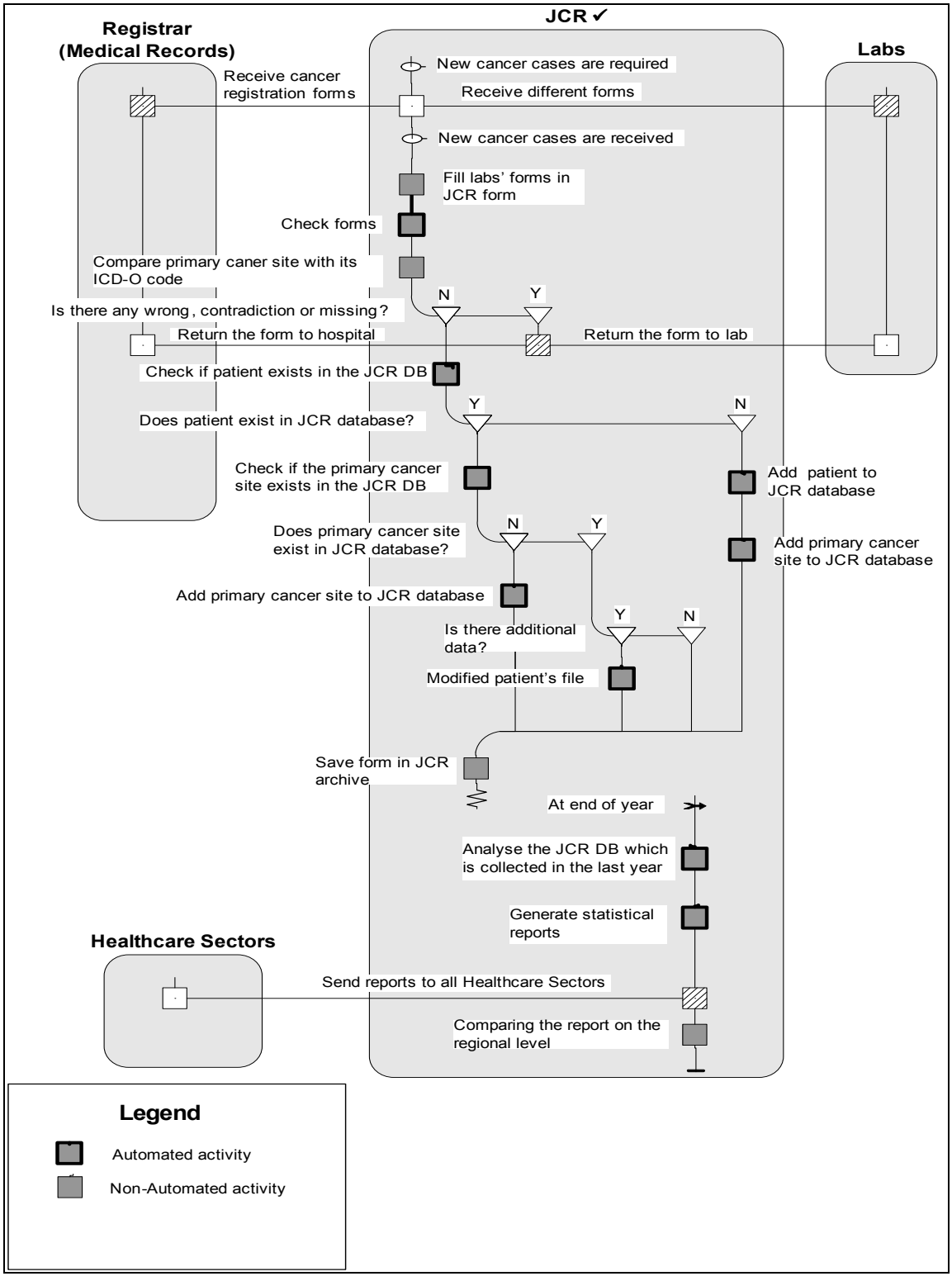

Figure 4: Improved RAD model of Cancer Registration Process

Table 1: Functional Requirements Document of CR process

Functional Requirements	Description
Check forms	• When the JCR receives cancer registration forms from registrars and laboratories, patients' personal information is checked to confirm that there is not any missing information
Check primary cancer site with its ICD-O code	• the primary cancer sites are verified against the international ICD-O (International Classification Diseases for Oncology) encoding
Check if the patient exists in the JCR Patient DB	• Identify whether the patient exists in JCR patient's DB
Add patient to JCR DB	• If the patient does not exist in JCR DB, then the patient's details are added to the JCR Patient's DB
Check if the primary cancer site exists in the JCR Cancer DB	• Identify whether the primary cancer site exists in JCR Cancer DB
Add new primary cancer site	• If the primary cancer site does not exist in JCR DB, the primary cancer site is added to the JCR Cancer DB
Modified patient's file	• If the patient's details and/or primary cancer site exist in JCR DBs, then patient's file is updated accordingly.
Analyze JCR DB	• Different types analyses can be performed • Data are retrieved from the JCR DBs to perfume the required analysis
Generate statistical report	• Different statistical reports can be performed. • Suitable analysis type is carried out to generate the required statistical report

Develop DFD Diagram Based on Functional specifications Document

DFD represents functions or processes which capture, manipulate, store, and distribute data between a system and its environment and between components within a system [6]. Functional specifications document may include huge information; this step focuses on coherently structuring that information through using DFD. DFD can be created based on the improved RAD model and the functional specifications document as they include functions, data stores, data flows, and external entities which are the main elements to build the DFD. For example, functional requirements such as check forms represent a process in DFD, JCR Patient's DB represent data store in DFD, and registrar represents external entity in DFD. Figure 5 shows DFD for CR process.

CONCLUSIONS

A new method for linking business process model and system model has been investigated in this research. This method aims to derive system models based on business process models. The method includes five steps namely: develop a business process model using RAD, identify automated activities, discover initial functional system requirements, create functional specifications document, and develop DFD based on functional specifications document. Role activity diagram has been used to model business process and data flow diagram to model software system. The congruence between the central notion of 'automated activity' in improved RAD model and that of 'process' in DFD facilitates the linking process. We used an example from a business process in healthcare (cancer registration in Jordan) to illustrate the argument and show an application of the method. In future research, we intend to develop and test further the procedures outlined here for producing a system model based on business process model using several cases with different domains.

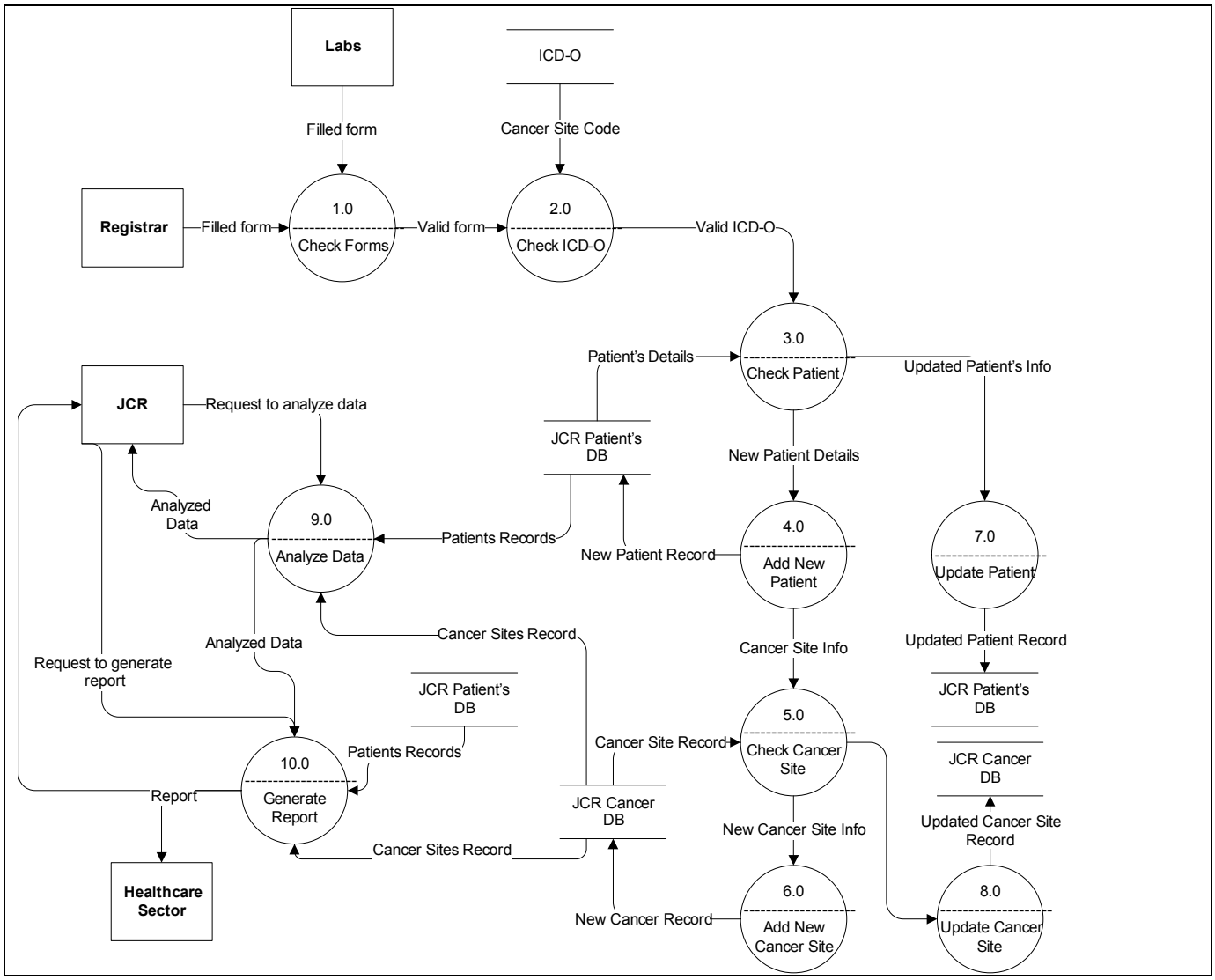

Figure 5: DFD for Cancer Registration Process

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