1. Introduction And Problem Statement

1.1 Introduction

Over the last decade there has been an increasing interest in information systems used to support, control, and monitor business processes. To implement automation techniques and control methods in the business processes it is necessary to apply modeling techniques for the non-technical and organizational systems and to extend the functionalities of the informational computer driven systems in the organizations. The automation of procedures where information, document or tasks are passed between participants according to defined set of rules to achieve or contribute to an overall business goal and a collection of procedures to amenable automation is workflow. Workflow management system is a system that defines, create and manage the execution of workflow through the use of software running on one or more workflow engines [5]. The WFMS should be able to interpret with the process definition, interact with the workflow participants and invoke IT tools and applications. WFMS support definition, creation, execution and general management of workflow. Workflow systems use a variety of languages based on different concepts. Most of the products use a proprietary language rather than an independent one. Some workflow systems are based on Petri nets but typically add product specific extensions and restrictions. The differences between the various tools are considerable. The reasons for the lack of consensus of what constitutes a workflow specification are the variety of the business processes. The absence of standard business process modeling concepts is the reason for the diversity in workflow languages. Respectively the comparison of different workflow products looks to be more as a dissemination of products than a critique of workflow language capabilities. They are many workflow system tools. Everyone has its own different feature, capabilities and shortcomings. But it's difficult to determine which tool is suiting the system requirements because there is no standard procedure for workflow system comparisons. Therefore we need to develop framework to compare workflow system tools to determine which tool suit the given requirements. We will compare JOGET and the ProcessMaker as case studies.

1.2 Importance Of Research

This research help determining which workflow system tool is the best to their system according to the requirements by knowing the feature, capabilities and shortcomings of the selected tools.

1.3 Problem Statement

Because of there are no standard procedures for the comparison between the workflow management system tools, it's difficult to determine which tool suits their system requirements. Therefore we need to develop a framework that compares workflow systems to know which workflow system tool is the most suitable to the intended system.

1.4 Objectives

- To identify workflow and the workflow management system.
- To identify some of workflow management system tools.
- To randomly choose two workflow management system tools to be compare based on availability and full documentations.
- To develop academic staff promotions system to be used in the compression process as a case study.
- To develop a framework to compare workflow system.

1.5 Methodology

- Gathering all the data related to the research.
- Provide a presentation of the current system.
- Determine the current system problems.
- Clarify the objectives of the research.

- Design a framework to achieve the objectives of Search.

- Present the proposed solution.

- Describe and identify the proposed solution.

- Determine the characteristics and advantages of the research.

- Provide a set of recommendations.

1.6 Thesis Scope and Limitations

This thesis compared two workflow system tools which are Joget and ProcessMaker according to the frameworks that consist of parameters needed when developing a workflow system. It focuses in functionality and does not have any comparison of internal structure of workflow system.

1.7 Thesis Structures

This Thesis contains six chapters. Chapter one is about Introduction and Problem statement and chapter two discuses the thesis's literature review. Chapter three talks about JOGET workflow and chapter four describe ProcessMaker. Chapter five contains the proposed comparison framework which describes the proposed framework, the implementation of the two selected workflow tools (Joget and ProcessMaker) and the comparison results. Finally chapter six is a conclusion and future work.

2. Literature Review

2.1 Introduction

In this chapter some of the backgrounds on workflow management concept and workflow management's tools are explained along side with some previous Researches about the comparison of workflow systems. This context will make it easier for the reader to understand this thesis.

2.2 Workflow Basic Concepts & Definitions

2.2.1 Workflow

In 1996, the Workflow Management Coalition (WFMC) published a glossary of all useful terms related to workflow. It defines workflow as "The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action (activities), according to a set of procedural rules"[1]. According to Van der Aalst and Van Hee [2], the term workflow management refers to" the ideas, methods, techniques, and software used to support structured business processes". Another definition of Workflow is "a collection of tasks organized to accomplish some business process (e.g., processing purchase orders over the phone, provisioning telephone service, processing insurance claims). A task can be performed by one or more software systems, one or a team of humans, or a combination of these. Human tasks include interacting with computers closely (e.g., providing input commands) or loosely (e.g., using computers only to indicate task progress)" [3].Also Workflow is" the automation of procedures where information, document or tasks are passed between participants according to defined set of rules to achieve or contribute to an overall business goal" [5].

The Researcher notice that the Van der Aalst and Van Hee definition is the most used definition among all definitions by the other researchers.

2.2.2   Workflow management system

Workflow management system is a system that defines, creates, and manages the execution of workflow through the use of software running on one or more workflow engines [3].

2.2.3   Business process

Workflow management systems are related to business processes. Van der Aalst and van Hee [2] define a business process as "A business process is one focused upon the production of particular products. These may be either physical products, such as an aircraft or bridge, or less tangible ones such as a design, a consultation paper, or an assessment. In other words, the "product" can also be a service."

2.2.4   Business process management

A business process managements are entails the assessment, analysis, Modeling, definition and subsequent operational implementation of the core business processes of an organization.

2.3 WFMC Reference model

Organizations making an investment in workflow software want to be sure that their investment is going to be protected. With standards users can have confidence that essential criteria will be met, hence reducing the risk involved. This clearly becomes of paramount importance when workflow systems are required to interoperate with those of other organizations whenever business processes are conducted across organizational

boundaries. The Coalition has developed a framework for the establishment of workflow standards. This framework includes five categories of interoperability and communication standards that will allow multiple workflow products to coexist and interoperate within a user's environment [14]. The reference model illustrates the major components and interfaces of a workflow management system. The workflow enactment service is the heart of a workflow management system. The workflow management coalition [1] defines the workflow enactment service as a software service that may consist of one or more workflow engines in order to create manage and execute a workflow process. The workflow enactment service manages the workflow process at runtime. In order to perform the process, the workflow enactment service interfaces with other components such as Process definition tool, Workflow client applications, Invoked applications, other workflow enactment services and Administration and monitoring tools.

2.4 Workflow Management System Tools

Workflow systems use a variety of languages based on different concepts. The differences between the various tools are considerable. The reasons for the lack of consensus of what constitutes a workflow specification are the variety of the business processes. There are many workflow tools like bpmn2bpel,YAWL, Kepler, Aperte, Apache Airavata, NOVA , jBPM Tool, Joget, Bonitasoft, Anduril, Together, ProcessMaker,…etc. This research covers two workflow tools Joget and ProcessMaker. The selection of the tools was done randomly based on availability and full documentations. Joget workflow is a people-driven, form-based workflow management system. This stand-alone application can manage and automate processes that are unique to each organization, creating added value. ProcessMaker is an open source workflow technology that provides companies with a graphical representation of their business activities and information flow, Chapter three contains more description of the two selected workflow tools.

2.5 Workflow Management System Tools Comparison

There is no standards procedure for the workflow management systems tools comparison. However there are some researches on the workflow management system tools. Some of these researches are summarized in the following section.

2.5.1 Delta: A Tool For Representing and Comparing Workflows

This paper is done by Nicholas Kong et al. Tutorials and sample workflows for complicated, feature rich software packages are widely available online. As a result users must differentiate between workflows to choose the most suitable one for their task. They present Delta, interactive workflow visualization and comparison tool that helps users identify the tradeoffs between workflows. They conducted an initial study to identify the set of attributes users attend to when comparing workflows, finding that they consider result quality, their knowledge of commands, and the efficiency of the workflow. They then designed Delta to surface these attributes at three granularities: a high-level, clustered view; an intermediate-level list view that contains workflow summaries; and a low-level detail view that allows users to compare two individual workflows. Finally, they conducted an evaluation of Delta on a small corpus of 30 workflows and found that the intermediate list view provided the best information density. They conclude with thoughts on how such a workflow comparison system could be scaled up to larger corpora in the future [11].

2.5.2 Open Source Workflow Management Systems: A Concise Survey

This survey is done by Ricardo Garcês, Tony de Jesus, Jorge Cardoso and Pedro Valente. The use of open source Workflow Management Systems (WFMS) is appealing for organizations due to its low cost and its customization capabilities. This paper analyzed ten different open source WFMS using a framework that offers decision makers

a starting point for selecting a workflow solution. The framework is to be used as a basis for characterizing WFMS based on a set of 22 parameters [8].

2.5.3   Scientific Workflow Systems - can one size fit all?

This paper is done by V. Curcin and M. Ghanem. This paper presents the state of the art in the field by reviewing six such systems: Discovery Net, Taverna, Triana, Kepler, Yawl and BPEL. We provide a high-level framework for comparing the systems based on their control flow and data flow properties with a view of both informing future research in the area by academic researchers and facilitating the selection of the most appropriate system for a specific application task by practitioners [12].

2.5.4   A Comparison of Different Workflow Modeling Tools

This study is done by Ammar Kamil, B.A.Sc. This study consists of two main parts: first, determining the best BPM (Business Process Management) tool for designing digital lab order process flows. The chosen tool was used to design an improved digital lab order process flow for

Humber River Hospital's lab order process in a highly advanced way; the new workflow tool enables the workflow process developer to better represent and analyze the process tasks based on the needs of the process flow. In the first part of the study, 15 open source workflow tools have been selected, and filtered them based on certain criteria, which include the availability of: analysis done by the tool, tool features, support, a graphical editor, an execution engine, and simulation. They chose four tools (YAWL, Together, Bonita soft, and NOVA) that satisfied these criteria. They evaluated each tool based on the outcome of the new workflow design by using the four selected workflow tools separately to design the new workflow process. They evaluated the tools by following a mixed qualitative and quantitative methodology by collecting qualitative data supported

by the quantitative data generated by the tools. Based on results from following the mixed methodology, as well as the results that were derived from studying the designated workflow process future lab ordering designing outcomes – They recommend YAWL (Yet Another Workflow Language) as the best workflow tool to use in the design of the new digital lab order process flow design. In the second part of the study They examined the current paper-based lab order process at Humber River Hospital; this included analyzing the process information to define the crucial points of errors in the process, bottlenecks of the process, most time consuming process tasks, and the main process points where improvements could be applied. The last part of part two was the design of a new fast and reliable digital lab order process system that used the Business Process Modeling (BPM) software tool selected in the second part of the thesis. During the research they collected lab order process data and used a qualitative methodology to analyze the data and find the critical phases in the current process in order to improve the new digital lab order process flow design. The results of this research will help in the development of future e-Health system processes by providing valuable data and recommending the right tool for designing a new process system. The new digital lab order process flow design will save healthcare time and money in addition to contributing to patient satisfaction. It will also provide more security to patient information than the old paper-based system. Notably, the chosen workflow tool has unique design features and components, which allow tool users to manage, control, and finish a successful workflow design efficiently, resulting in reliable digital lab order process flow design [13].

3. Workflow tools

3.1 Introduction

This chapter define two of workflow management's system tools which are Joget and ProcessMaker. In Joget its describes Joget Features, Characteristics and plugins. Moreover it also illustrate how to used Joget in Admission Process. In ProcessMaker its describes ProcessMaker Definitions, Cases Inbox, User Management, Processes, Tasks, Steps, DyanForms, Input Documents, Output Documents, Triggers, Work Flows, Enterprise Plugins and Addons and Business Rules Engine.

3.2 What is Joget Workflow?

Joget workflow is a people-driven, form-based workflow management system. This stand-alone application can manage and automate processes that are unique to each organization, creating added value. Joget system serves as a platform for users to design, deploy and run different types of workflows for different types of organizational processes. Workflow designers can create dynamic workflows that can be updated anytime. Each activity can be mapped with a form to capture the user's input, while serving as a plugin for system integration.

Figure [3.1] Joget Workflow Architecture

3.3 Joget Key Features

Joget key features are divided into three categories Workflow Designer, Workflow Engine and Workflow Management Console.

3.3.1 Workflow Designer

Workflow Designer contains a graphical tool that enables the creation of visual process flows in business processes, From routing, verification and escalation of tasks, to reminders and email notifications – these can all be easily addressed and created with Workflow Designer.

3.3.2   Workflow Engine

Joget workflow engine executes processes deployed from the Workflow Designer. It also supports the XPDL standard. The engine allows for easy integration to external systems by providing a simple HTTP-based API along with Java and JavaScript libraries.

3.3.3   Workflow Management Console

Web-based console consisting of Inbox/Task Manager, Form Builder , Workflow Monitor, User Manager and System Settings

3.4 Joget Key Characteristics

Joget is XPDL compliant and it contains Plug-in Architecture to Extend Its Usability. It can be used on its own to manage the flow of processes and data captured from forms. Joget can be seamlessly integrated in various ways to your existing systems to build complete applications tailor-fit to your unique needs. Joget is capable of synchronous and asynchronous integration. It also provides the ability to automate, manage and continuously improve business processes, while reducing the burden of paper-based work. Joget also can be integrated to other portals or system applications using AJAX or JSON API.

3.5 Joget In Admission Process

In order to use joget in Admission Process, we have to customize the software. For this purpose; the software provided you support in Directory Manager, Form Variables and System Tools. In Directory Manager Security is crucial for admission process [ID cards issuance, Calling Al-jamiah Database]. Directory Manager provides an alternate

security matrix within joget that can also be used by any 3rd party system for authentication purpose. Form Variables used to integrate specific elements of your form to external sources .We can use them to integrate new system with previous data forms. System Tools are also available for this purpose.

3.6 Joget Workflow Plugins

Joget workflow contains eleven plugins for the purpose of automate Admission Process. This plugins are Abort Activity Plugin, Deadline Plugin, Department Variable Plugin, Enterprise Email Plugin, Enterprise MySQL Plugin, LDAP Plugin, PDF Plugin, Post Assignment Acceptance Plugin, SOAP Plugin, Start Process Plugin and XML Plugin. Abort activity plugin aborts activity instances in a running process instance. Deadline plugin provides advanced controls over interpretation of deadline of a process activity, to exclude deadline calculation from public holidays, weekends and non-working hours. Department Variable Plugin returns a list of departments (created in organization chart) to be populated into multi-valued form field, such as select box, check box and radio button. Enterprise Email Plugin is to send email message to targeted recipient(s) through a set of primary and secondary SMTP servers. Enterprise MySQL Plugin is used as Application Plugin, Enterprise MySQL Plugin allows extraction, transformation and execution of SQL statements via MySQL connector. LDAP Plugin provides a user directory implementation that retrieves user and group information from an LDAP server. PDF plugin used to generate PDF file into a designated directory, with user-defined textual content. Post Assignment Acceptance Plugin is used when triggered a HTTP URL, every time when an assignment of user-defined activities is accepted. SOAP (Simple Object Access Protocol) is a simple XML-based protocol to let applications exchange information over HTTP. Or more simply SOAP is a protocol for accessing a Web Service. SOAP Plugin consumes a SOAP web service, and inserts the formatted response into form data table. Start Process Plugin used to automatically starts another process, when a process is completed. XML Plugin reads a XML feed URL, and inserts formatted data into form data table.

3.7 ProcessMaker Definitions

ProcessMaker is an open source workflow technology that provides companies with a graphical representation of their business activities and information flow. ProcessMaker automates form based, approval driven workflow that improves the way information flows between data and systems. ProcessMaker has been downloaded more than 1,000,000 times and is currently being used by thousands of companies around the world. ProcessMaker has a network of more than 35 partners located on 5 different continents

3.7.1 Process

A Process, which is the term we use to refer to a Business Process, is a collection of tasks that takes one or more kinds of input and creates an output that is of value to the customer or to an end user within the organization. The process output can be a tangible good or a service

.

3.7.2 Task

A task is the definition of a logical group of sequential steps, sharing a common goal. A task is composed of one or several steps. The first step in creating a Process is to define the tasks. In ProcessMaker a task is a logical group of sequential steps, sharing a common goal. Tasks can be assigned to different users or groups of users, so that a process can be used to coordinate the activities of different people or groups in an organization.

3.7.3 Step

A step is a piece of work that forms a clearly defined action. A step may be a manual action, or a workflow (automated) action. Examples of steps: upload a document, fill a form, and download a PDF or DOC document. In ProcessMaker a step is a piece of work that forms a clearly defined action within a task. There are four types of actions. They are Dynaform fill a form, Input Document upload a document, Output Document download a document and Triggers – provide appropriate framework to perform complex calculations and add additional functionality to processes.

3.7.4 Case

A case is an instance of a process definition. In other words, a business case can be seen as a work in progress. For example, to start a process, a case must be initiated in order to execute it. This case must complete the cycle, it means if a case has started it must end with the same number. Case variables are special variables which hold information about a ProcessMaker case and are only valid while that case is running.
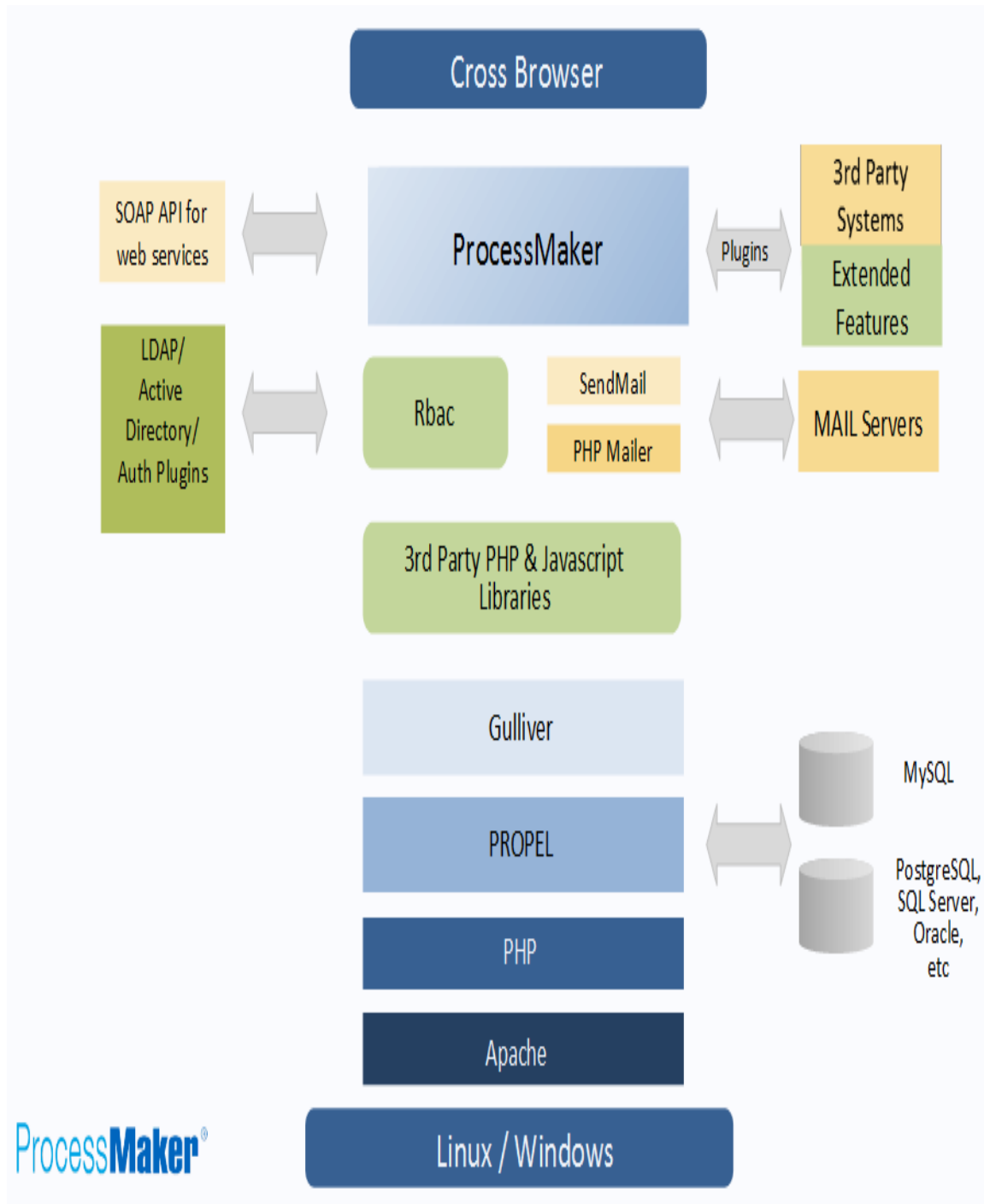
Figure [4.1]ProcessMaker Architecture Diagram

3.8 ProcessMaker Features

3.8.1 Cases Inbox

The Cases Inbox is the heart of the end user experience in ProcessMaker. It is where the end user interaction takes place. The layout has been designed to appear similar to an email client with a list of folders on the left of the screen separating cases between an inbox, drafts, participated (or sent) as well as several other folder features unique to ProcessMaker. Cases within the inbox can be sorted, filtered and searched through. Users can also sort the case list in a variety of ways by clicking on a column header.

3.8.2 User Management

ProcessMaker organizes system users into users, groups, departments and roles. User accounts in processMaker which usually represents a person in your organization but can also represent an account with special privileges such as the "admin" account. Roles make it possible to define customized roles with different levels of permissions, so that the functions and privileges of different users can be easily controlled and managed. Groups users can be assigned to zero, one, or more groups. A group of users simplifies the assignment of tasks. For example, a Help Desk process may involve a pool of customer support clerks, all belonging to a user group named Customer Support. Departments arrange the users under an organizational structure.

3.8.3 Dynaform

DynaForms, or Dynamic Forms, are the custom forms which can be designed in ProcessMaker to interface with the user while running a case. DynaForms allow users to view and enter data into cases in a graphical interface which should be intuitive for even non-technical users. Dynaform field names must be unique.

3.8.4 Input Documents

An Input Document is a box to hold a file or files associated with a particular case. These files can be text documents, spreadsheets, images or any other kind of file. An Input Document can be a hard copy (which has been printed out and stored in a filing cabinet), a digital file which is uploaded to the case, or both. An Input Document can be added as a step in a task or as a file object in a DynaForm.

3.8.5   Output Documents

Output Documents are files generated while running a case, which are meant to be printed out or stored digitally outside ProcessMaker. Output Documents are useful for creating external records of case data, as well as creating formatted output such as bills,

receipts, and letters. They are generated from HTML templates containing references to system and case variables, which are auto-inserted when the Output Document is generated as a step when running a case.

3.8.6 Triggers

A trigger is a piece of PHP code that can be inserted into a process. Triggers provide the appropriate framework to perform complex calculations and add additional functionality to processes. A ProcessMaker trigger is parsed like a PHP script, so normal PHP variables and functions can used inside triggers, as well as ProcessMaker's case variables, system variables and its custom functions. PHP libraries can also be imported into ProcessMaker triggers with the include_once() function. With access to the PHP language and its libraries, a great deal of functionality can be added to a trigger.

3.8.7 Work Flows

Various types of work flows, Sequential workflow automatically flows to subsequent tasks, so no special configuration is required, after connecting the tasks. Selection workflow allows the user assigned to the task to manually select which task will be the next in the workflow. Evaluation workflow uses a condition to decide whether the workflow moves to subsequent task(s). If the condition, which is a PHP expression, evaluates to true, then the workflow will move to the subsequent task.

3.8.8 Enterprise Plugins and Add-ons

List of Enterprise plug-ins includes features and functionality that extend and enhance ProcessMaker's performance and functionality. Plugins are only available together with Enterprise Subscription Plans. Commonly used plugins are Business Rules Engine, Enterprise Data Search, Advanced Dashboards, Simple Report Manager, Version Upgrade Manager and Advanced LDAP/AD Sync.

3.8.9 Business Rules Engine

A business rule is a group of rules that captures and implements business policies and practices. A rule can enforce business policy, make a decision, or generate new data from existing data. The Business Rules plugin is intended to help process designers to define Business Logic rule sets and share them among cases. These rules will be defined for each process by using a graphical interface which makes the definition easy-to-understand. The rule sets are executed by a trigger.

3.9 Conclusion and discussion

Joget workflow is a people-driven, form-based workflow management system it has a good number of feature like Designer, Engine and Management Console. Joget is XPDL compliant and it contains plug-in Architecture to Extend Its Usability. It contain eleven Plug-in which is a lot. It used plugin for the purpose of automate Admission Process because in order to use joget in Admission Process, we have to customize the software. Overall joget is a very rich workflow tools.

ProcessMaker automates form based, approval driven workflow that improves the way information flows between data and systems. Start with designing process. A Process, which is the term we use to refer to a Business Process, is a collection of tasks. A task is the definition of a logical group of sequential steps. step is a piece of work that forms a clearly defined action. Finally, A case is an instance of a process definition. ProcessMaker contain features like Cases Inbox, User Management, Dynaform, Input Documents, Output Documents and Triggers. It also contains some plugin, addson and engine.

4. The proposed Framework

4.1 Introduction

The use of Workflow Management Systems (WfMS) is appealing for organizations due to its low or inexistent cost and its customization capabilities. In this chapter the researcher proposed a framework that offers decision makers a starting point for selecting a workflow solution.

Nowadays, many organizations benefit from the use of open source software. Open source software is having a growing impact on the software industry by becoming an important competitor to commercial software. The selection of an open source WfMS solution may be very difficult and complex. A selection requires a complete analysis of the most popular solutions available. Otherwise, it may lead to the choice of an inadequate workflow product that will not support efficiently the business processes of an organization. This chapter proposed a comparison framework and offers comparison of two popular open source WfMS using the proposed framework for decision makers, providing a starting point to the complex process of selecting an open source WfMS. Moreover this chapter describes the promotions process as workflow case study, analyze this process and perform it on the two selected workflow system tool (Joget and processMaker) and obtain the comparison result.

4.2 Wfms Comparison Framework

Several approaches have been proposed to compare information systems and information technologies. They have been provided by prestigious consulting companies such as Andersen Worldwide, Ernst & Young, Deloitte & Touche, Coopers & Lybrand, KPMG and Price Waterhouse. Since workflow technologies have specific characteristics, existing approaches do not address many important perspectives. Therefore firstly, the research want to determine what functionalities are provided by WfMS. Secondly, the research also want to evaluate the installation and usage of WfMS, as well as the

definition of workflow processes. For this reason, the research will focus the attention on the compliance of WfMS with the WfMC reference model [6] and on functional area.

4.2.1   WfMC Reference Model

WfMC reference model is a general description of the architecture of a workflow management system, in which the main components and the associated interfaces are described. In the workflow reference model, a workflow engine operates based on one or more workflow definitions. In the workflow reference model, the tools for constructing these workflow definitions are known as process definition tools (Interface 1). Those employees who are only involved in the actual execution of a workflow process will never use the process definition tools. The only contact they have with the workflow management system is through the workflow client applications (Interface 2). The performing of an activity may result in the starting up of one or more applications. These do not form a part of the workflow management system because they are associated with the actual performance of work, not to its logistical management. Such applications do belong to the workflow system. These applications can be fully automatic applications or interactive these applications are known as invoked applications (Interface 3). A workflow system may contain several workflow engines. These come under the same management and use the same workflow definitions. Besides, it may also able interaction with other workflow engines (Interface 4). The workflow enactment service ensures the processing of cases based upon workflow definitions. The supervision and operational management of these flows (including the resources) are done using administration and monitoring tools (Interface 5) [1].
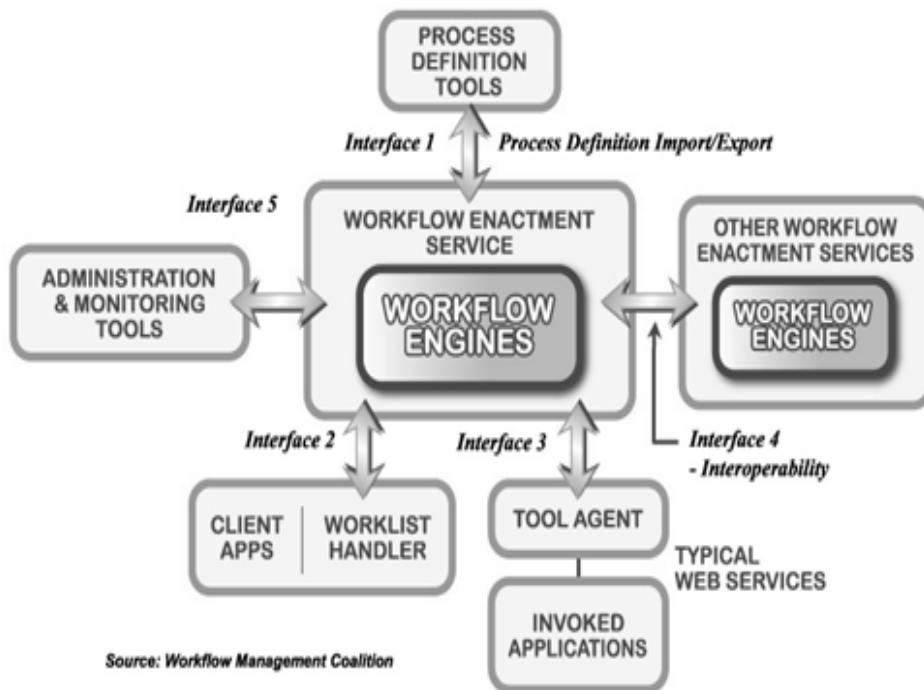
Figure [4.1] WfMC Reference Model[6]

4.2.2 Functional Areas

All WFM systems may be characterized as providing support in three functional areas the Build-time functions, Run-time control functions and Run-time interactions. Build-time functions concerned with defining, and possibly modelling, the workflow process and its constituent activities. Run-time control functions concerned with managing the workflow processes in an operational environment and sequencing the various activities to be handled as part of each process. Run-time interactions with human users and IT application tools for processing the various activity steps. Figure [4.2] illustrates the basic characteristics of WFM systems and the relationships between these main functions.
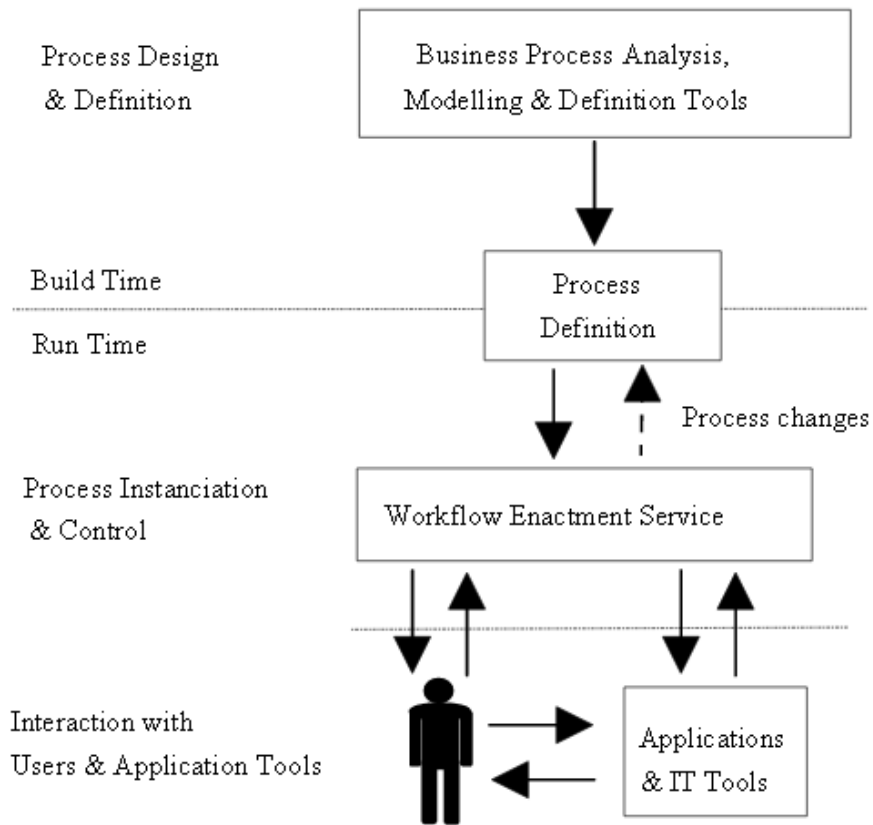
Figure [4.2] WFM systems basic characteristics[6]

4.2.3   Comparison Framework

Comparison Framework used in this thesis consists of WfMC Reference Model Interfaces and functional areas. According to Garcês et al. survey the functional areas are associated with the Research Scope, Documentation, Platform Independent, Easiness of Installation and Utilization, Other software required, Web Based, Middleware Platform, DBMS Integration, Transactions Support, Easiness of the Process Definition and Workflow Language [8]. This research adds four other functional areas Parallel Task Support, user views, Email server, and Variables. Parallel task support means that the task can be parallel not only sequential. User view means that graphical user interface can

be design. Email Server it's about how emails work in the tools, sending and receiving email from participants and nonparticipants. Variables is about how variables used.

WfMC Reference Model Interfaces	Process Definition Application (Interface 1)
	Workflow Client Application (Interface 2)
	Invoked Applications (Interface 3)
	Other Workflow Enactment Services (Interface 4)
	Administration and Monitoring tools (Interface 5)
Functional Area	Research Scope
	Documentation
	Platform Independent
	Easiness of Installation and Utilization
	Other software required
	Web Based
	Middleware Platform
	DBMS Integration
	Transactions Support
	Easiness of the Process Definition
	Organizational Perspective
	Workflow Language
	Parallel Task Support
	User views
	Email server
	Variables

Table [4.1] the Comparison Framework

4.3 Comparison Environment

For this thesis two open source workflow systems available nowadays have been chosen. The final set that we will analyze in this chapter is composed of the following WfMS: Joget and Process Maker. The installation and test of the workflow systems was made by a student in Computer Science within the scope of their final project. All the WfMS analyzed were installed and tested in an Intel ® Core™ i5-3230M CPU @ 2.60GHz computer with 4.00 GB memory, System type 64-bit, 1TBdisk space and running Windows 10.

4.4 Case Study

4.4.1 Academic Staff Promotion Application System Description

The manipulation of Academic Staff Promotion Application system is complicated task that contain many participants like the applicant, head of department, college dean, vice chancellor, small promotion committee, promotion committee and three judges. The promotion process start with the applicant who fill promotion application form and up load his documents then the form and document are pass to the head of department to check them and write a report about the applicant then process passes to the applicant's college dean who also write a report. All this forms and documents pass to the vice chancellor who check them and make a decision. If the decision is reject the process come to end but if the decision is approve then the applicant's documents send to the small promotions committee who check the documents and make sure it's correct then give their recommendations about the applicant and send it to the promotions committee. The promotions committee makes a decision. If the decision is reject the process come to end but if the decision is approve then the applicant's college dean suggest five judges the vice chancellor select three of them. The three selected judges make their decisions and send it to the promotions committee, who make the final decision to accept or reject the promotion.
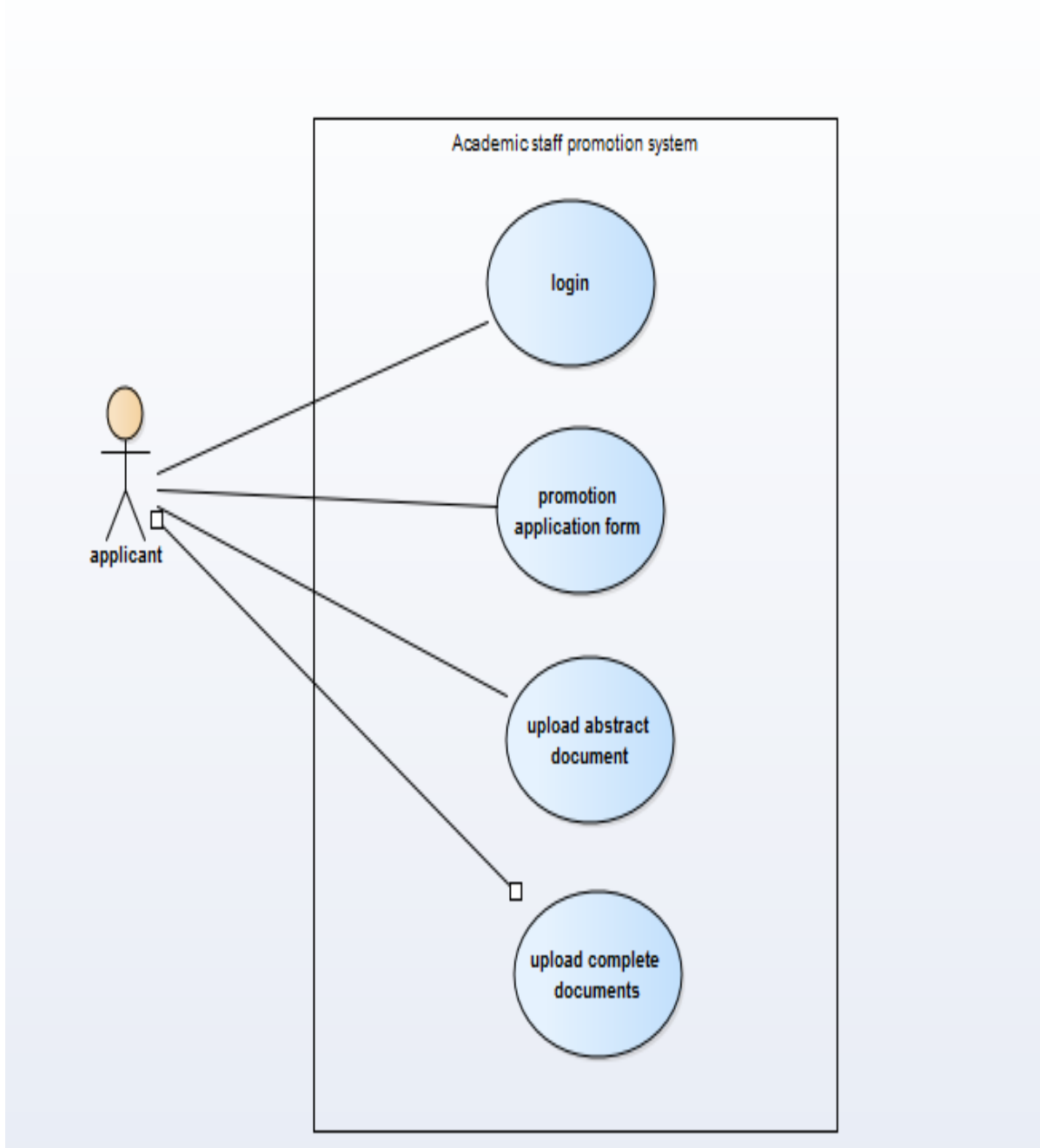
4.4.2 Use case Diagram

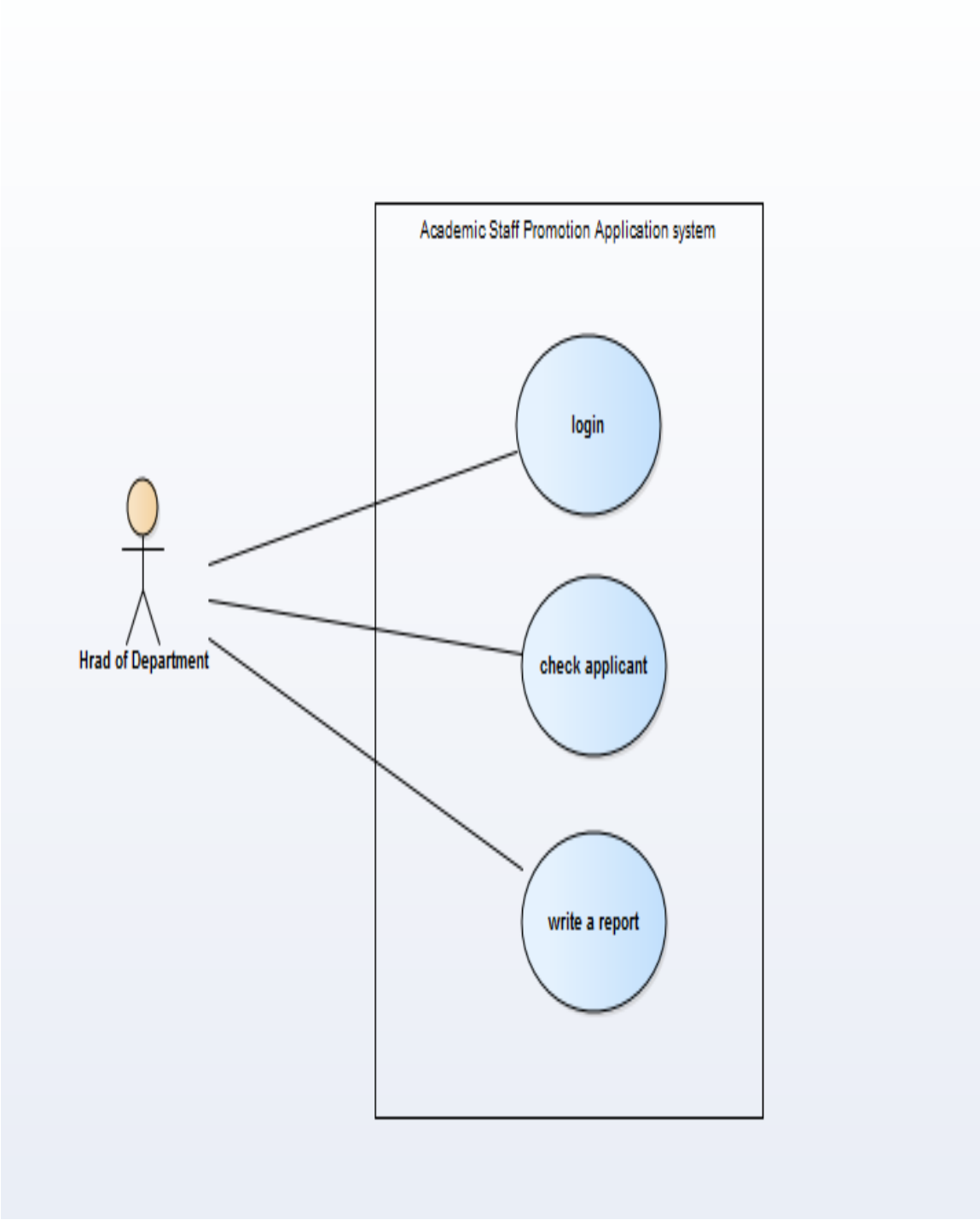**Figure [5] Applicant Use Case Diagram**

Academic Staff Promotion Application system

login

check applicant

write a report

Hrad of Department

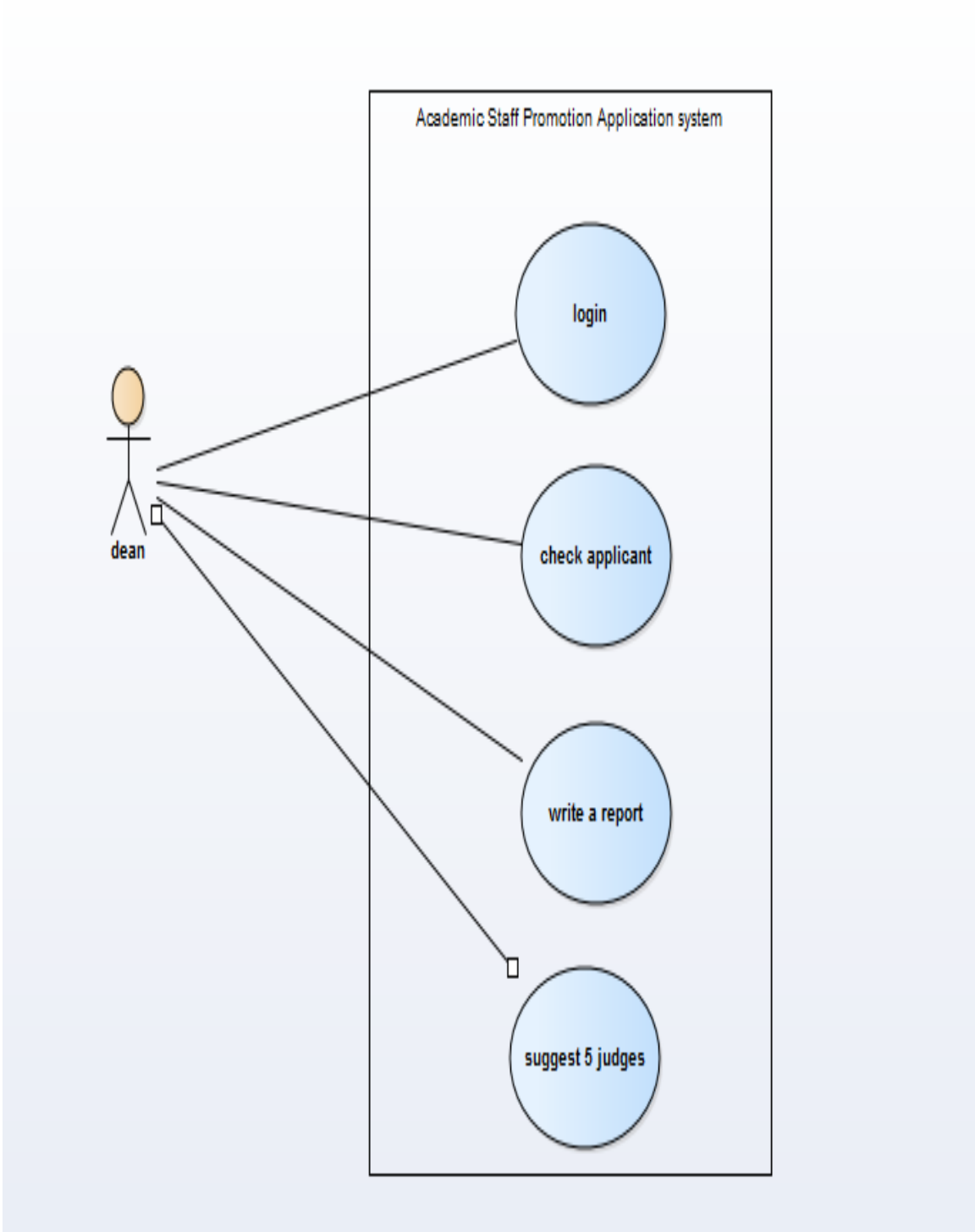**Figure [6] Head of Department Use Case diagram**

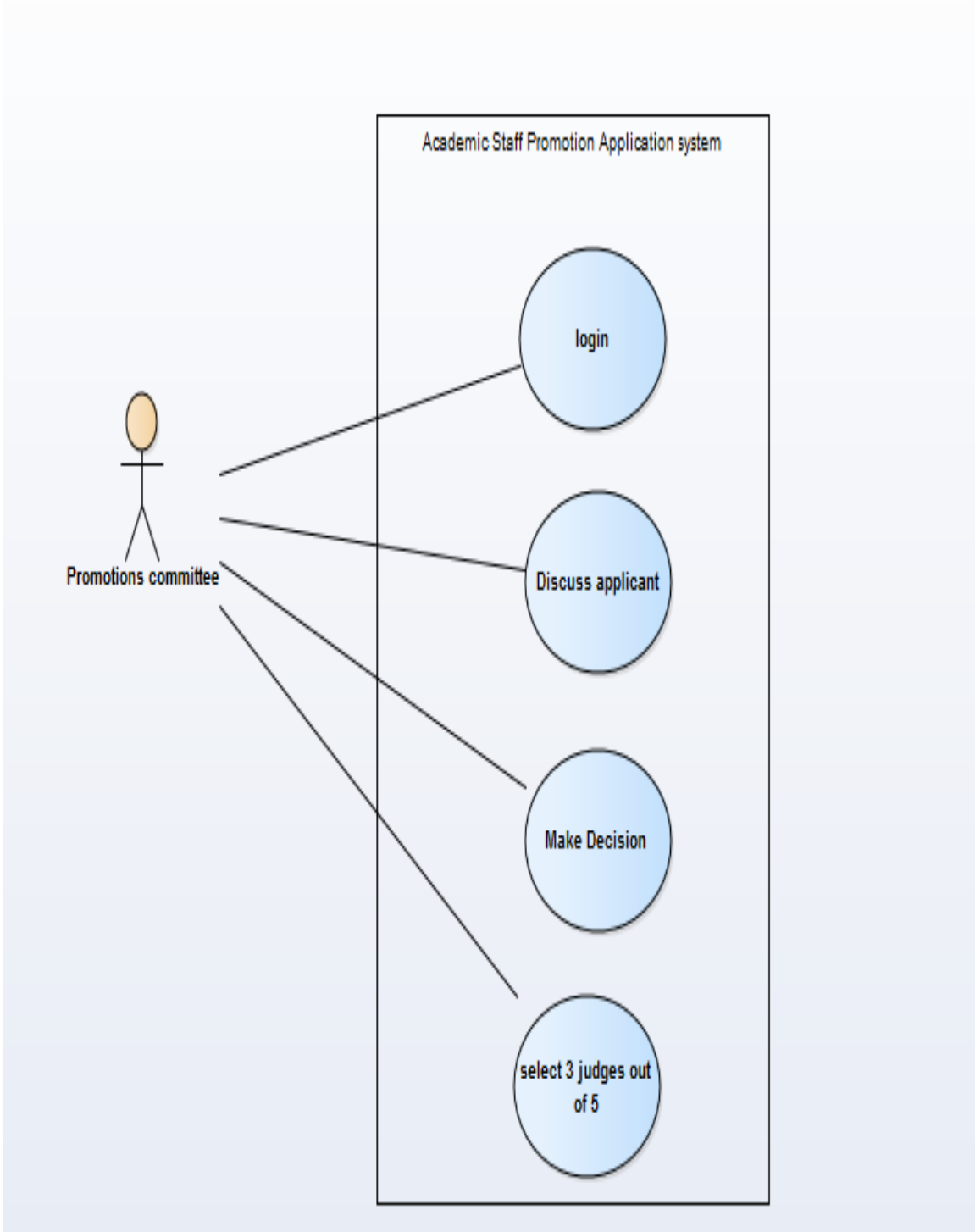**Figure [7] Dean Use Case Diagram**
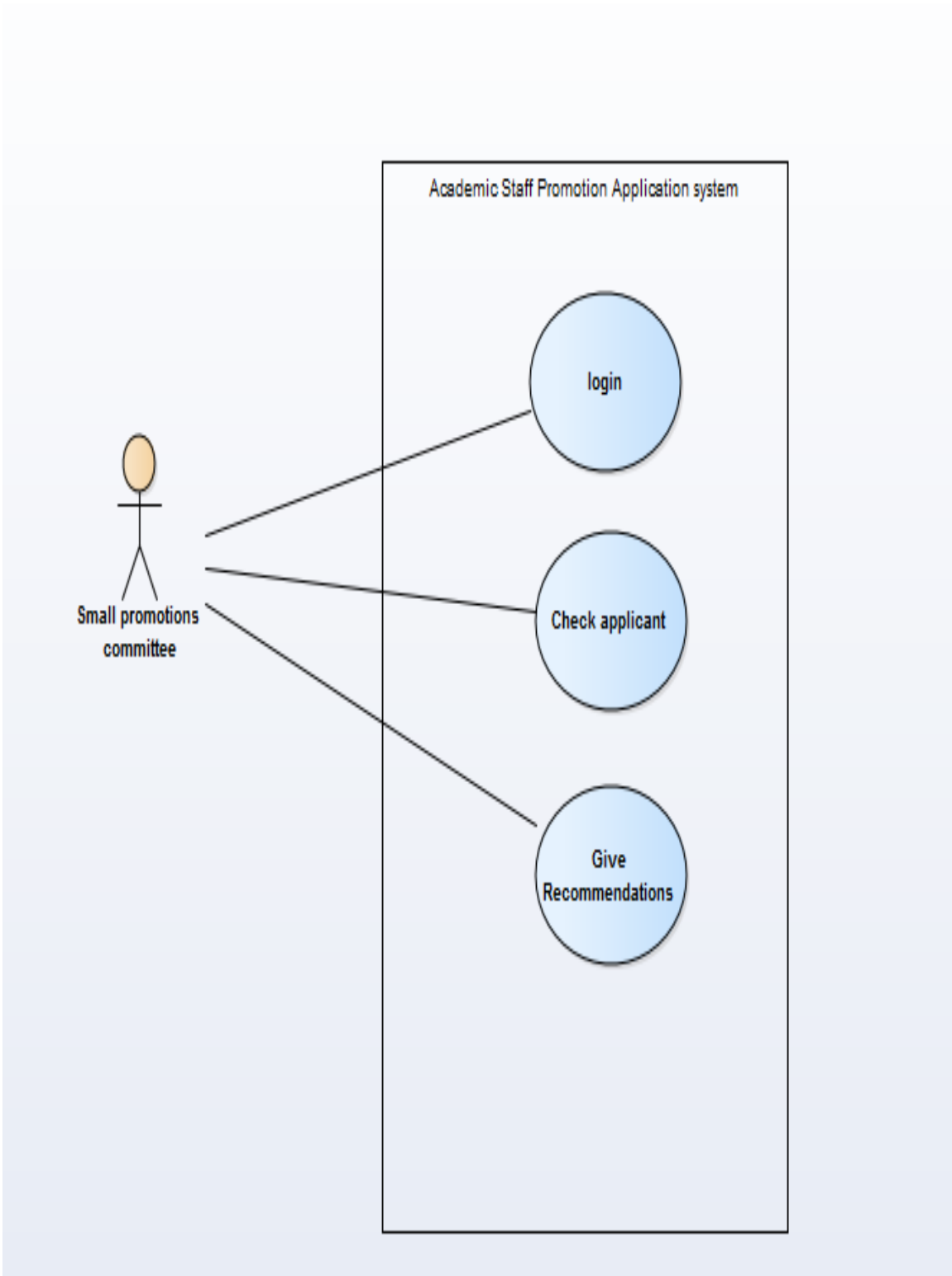
Figure [8] Vice Chancellor Use Case Diagram
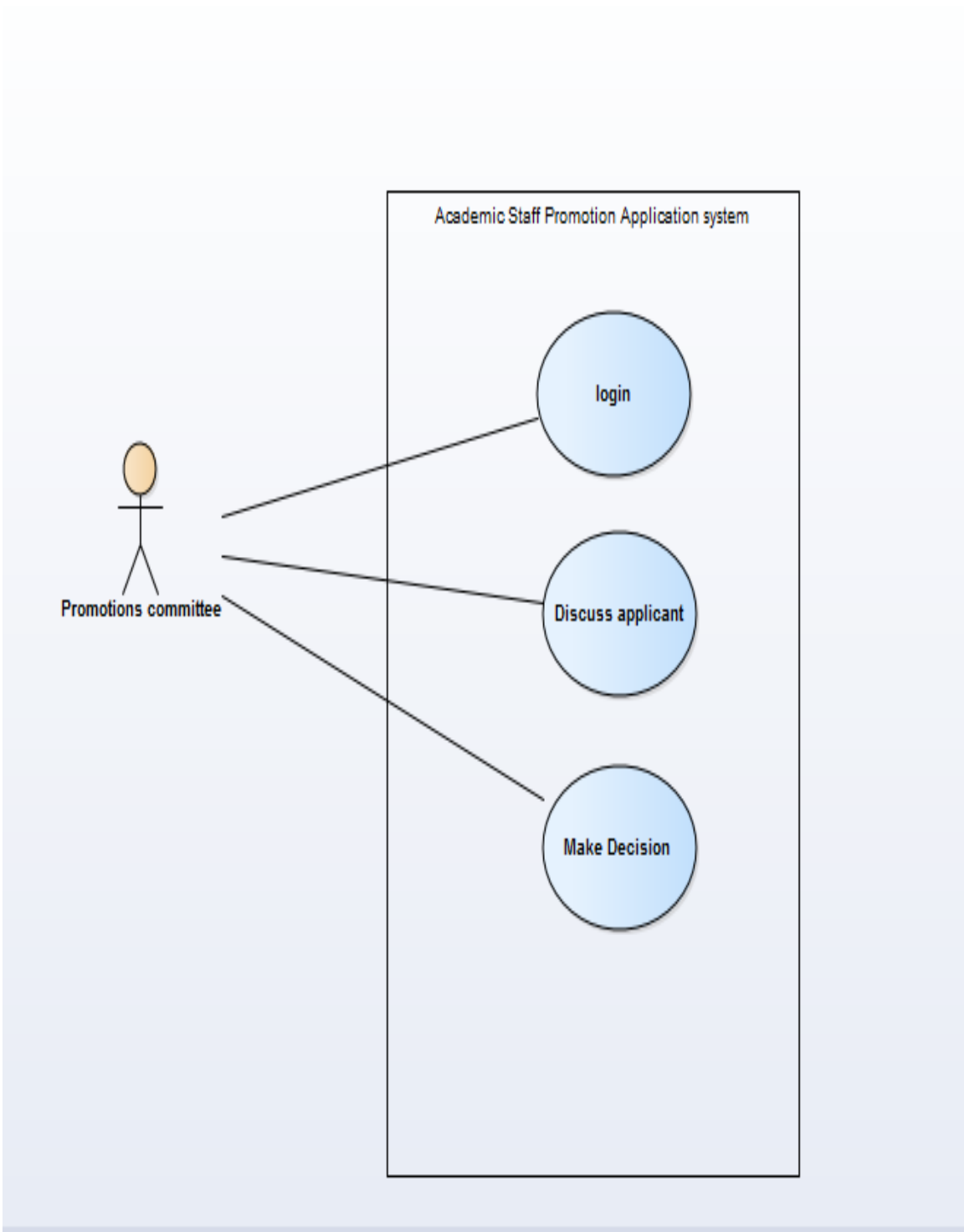
Figure [9] Small Promotions Committee Use Case Diagram

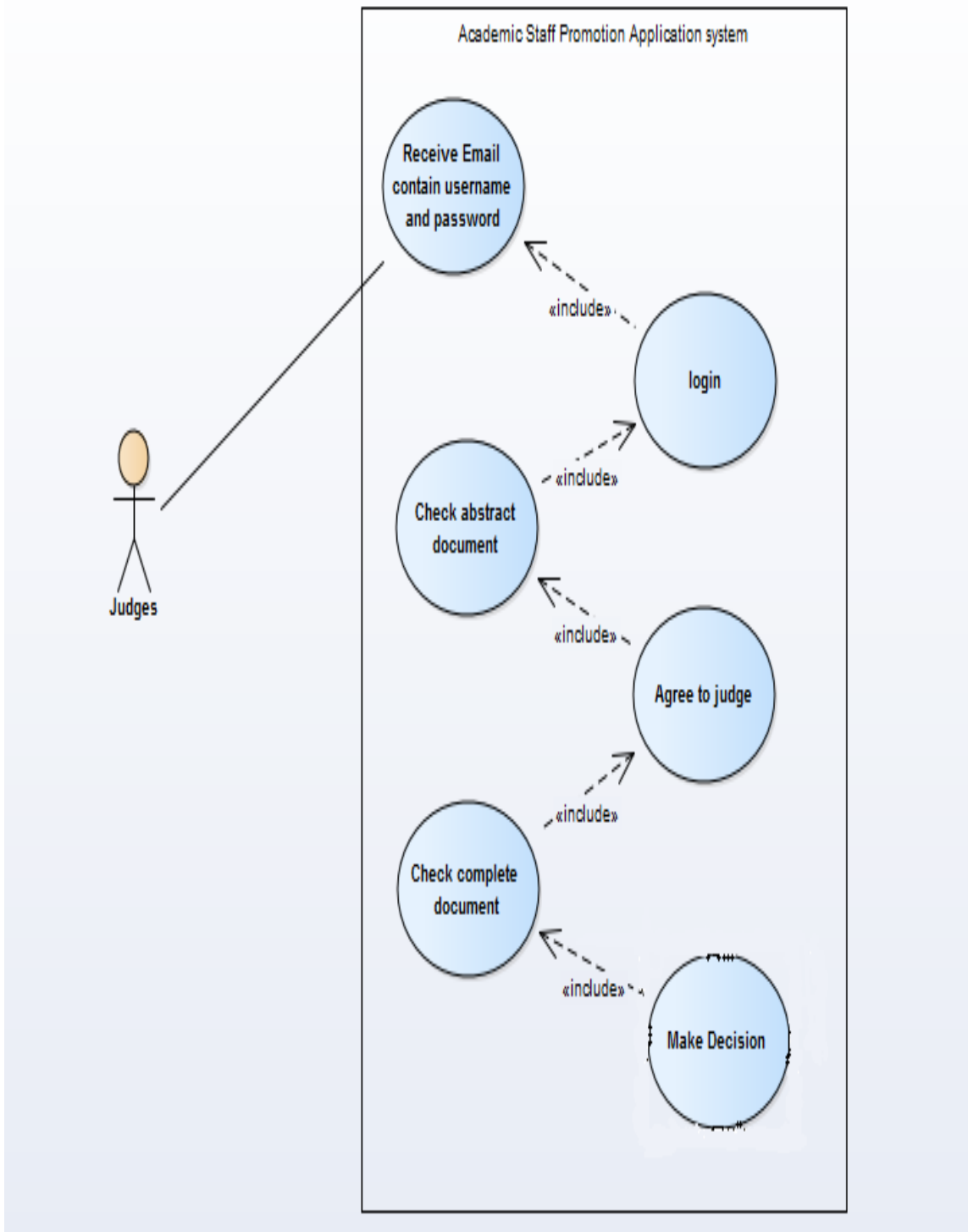**Figure [10] Promotions Committee Use Case Diagram**
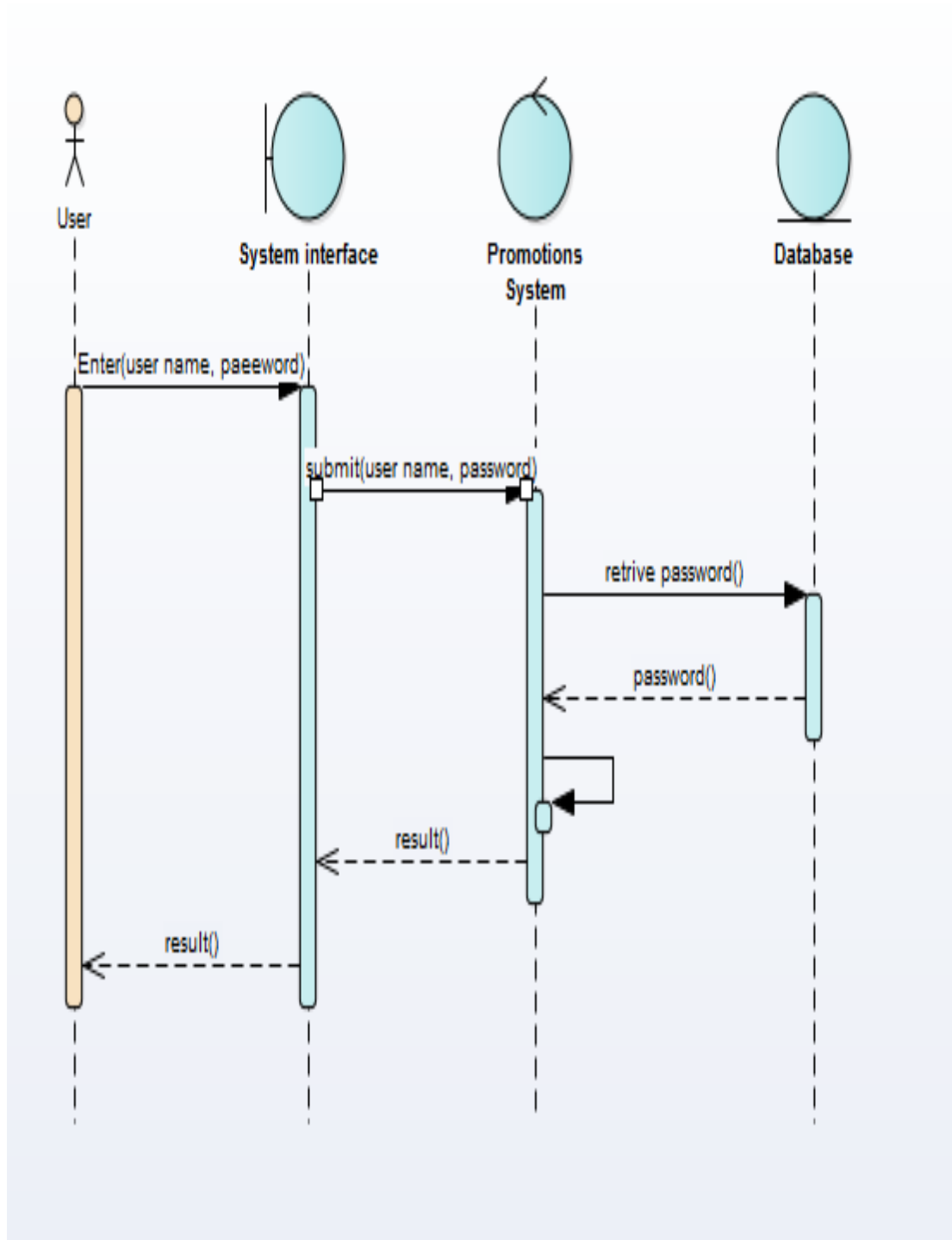
Figure [11] Judges Use Case Diagram

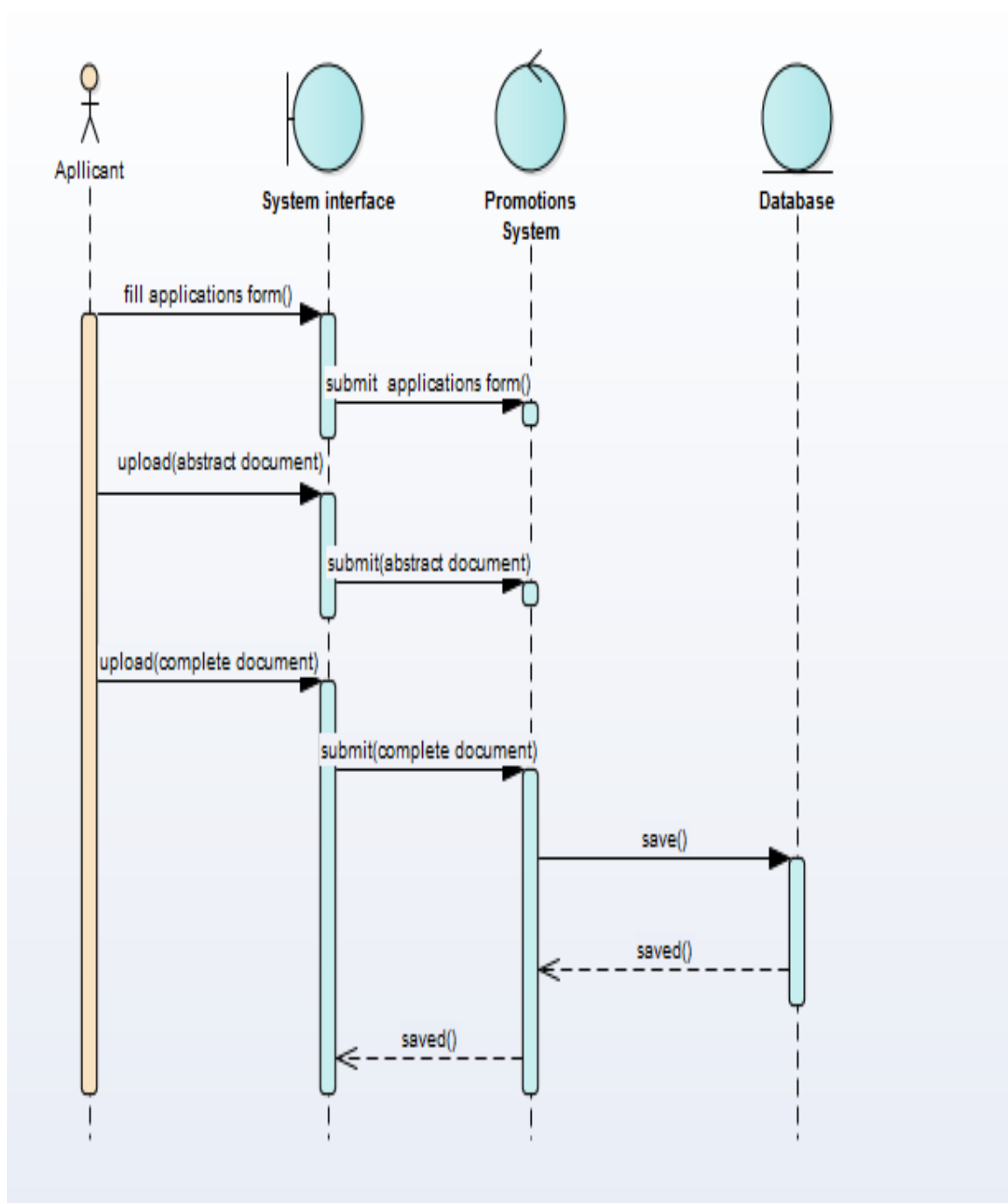### 4.4.3 Sequence Diagram

Figure [12] Login Sequence Diagram
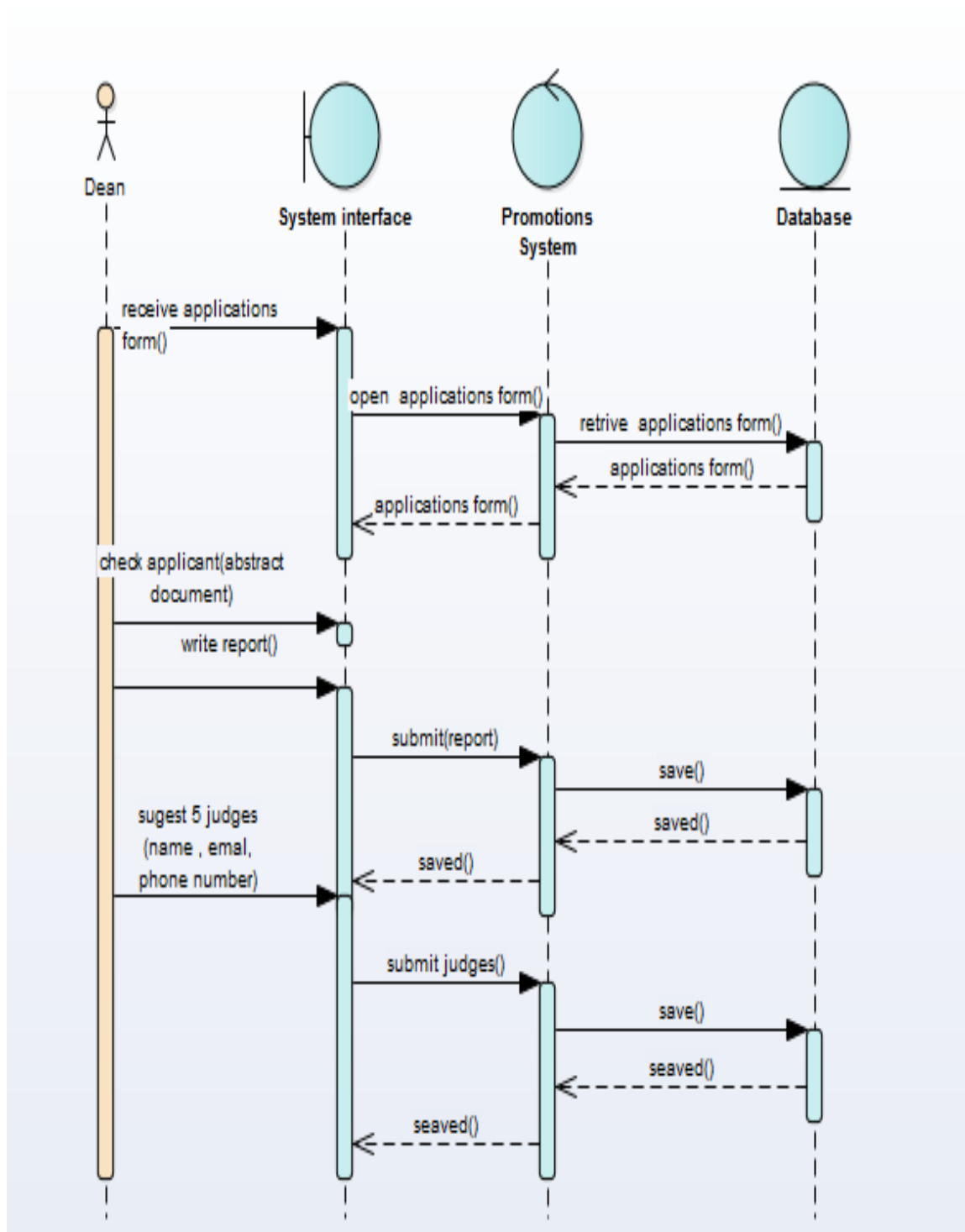
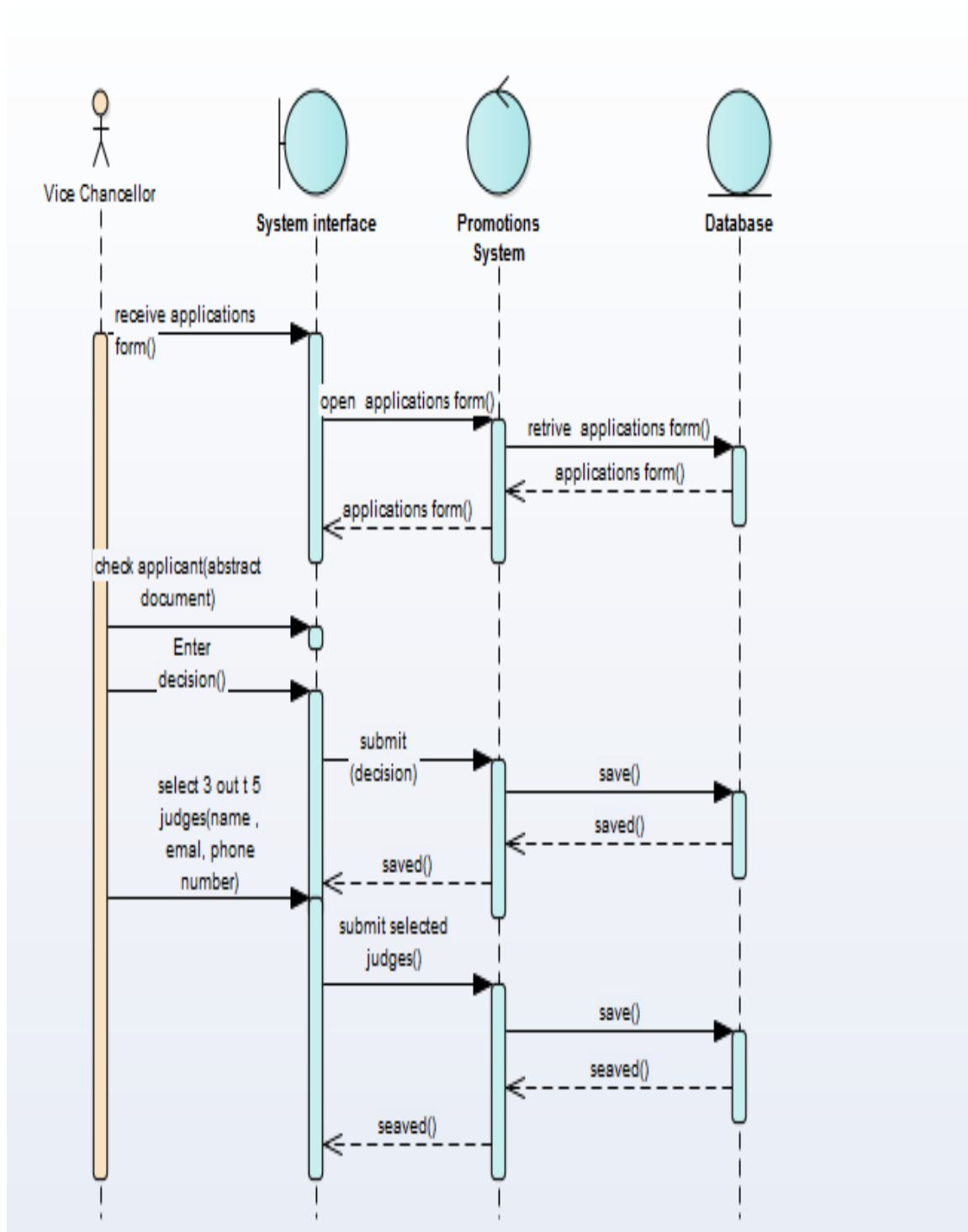**Figure [13] Login Sequence Diagram**

Figure [14] Dean Sequence Diagram

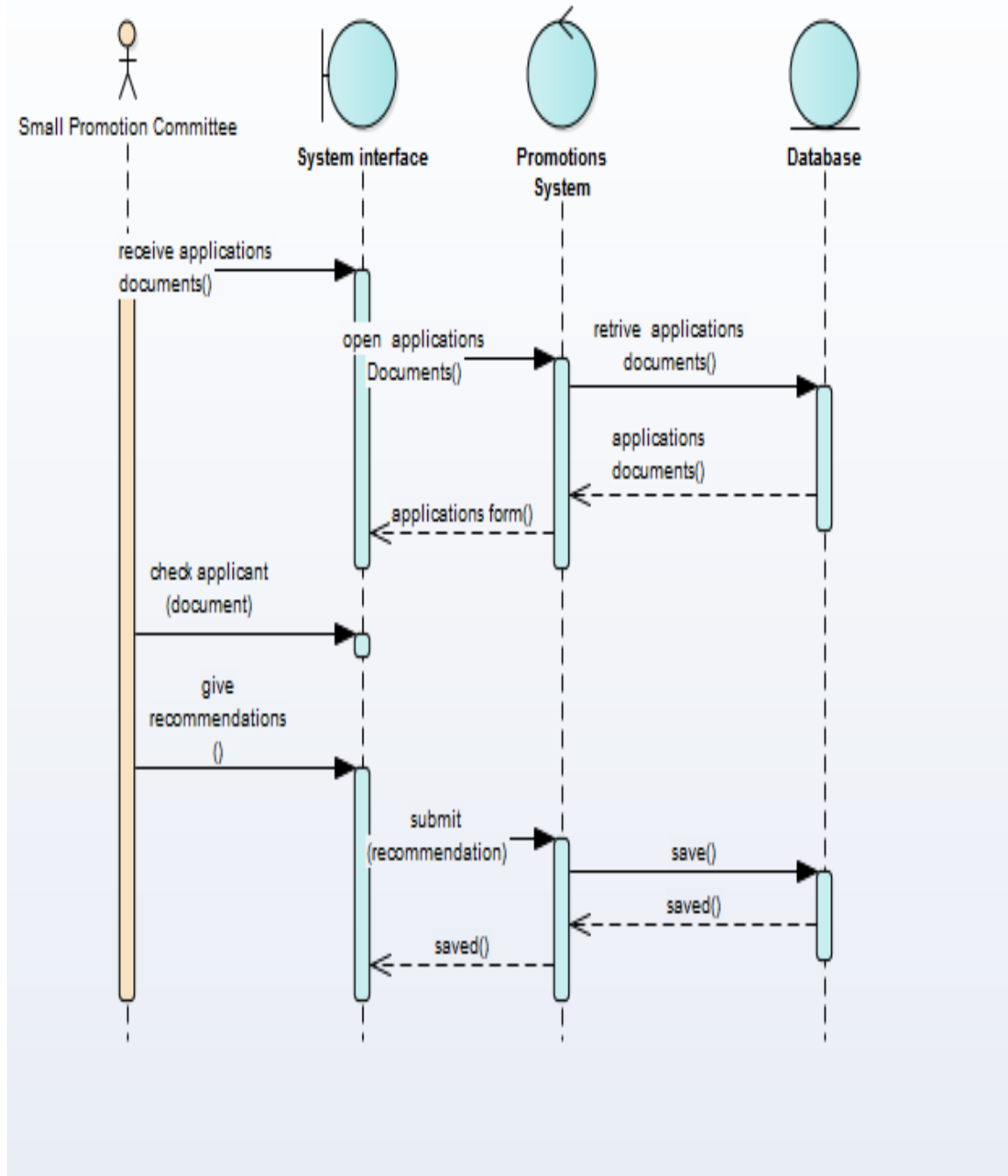**Figure [15] Vice Chancellor Sequence Diagram**
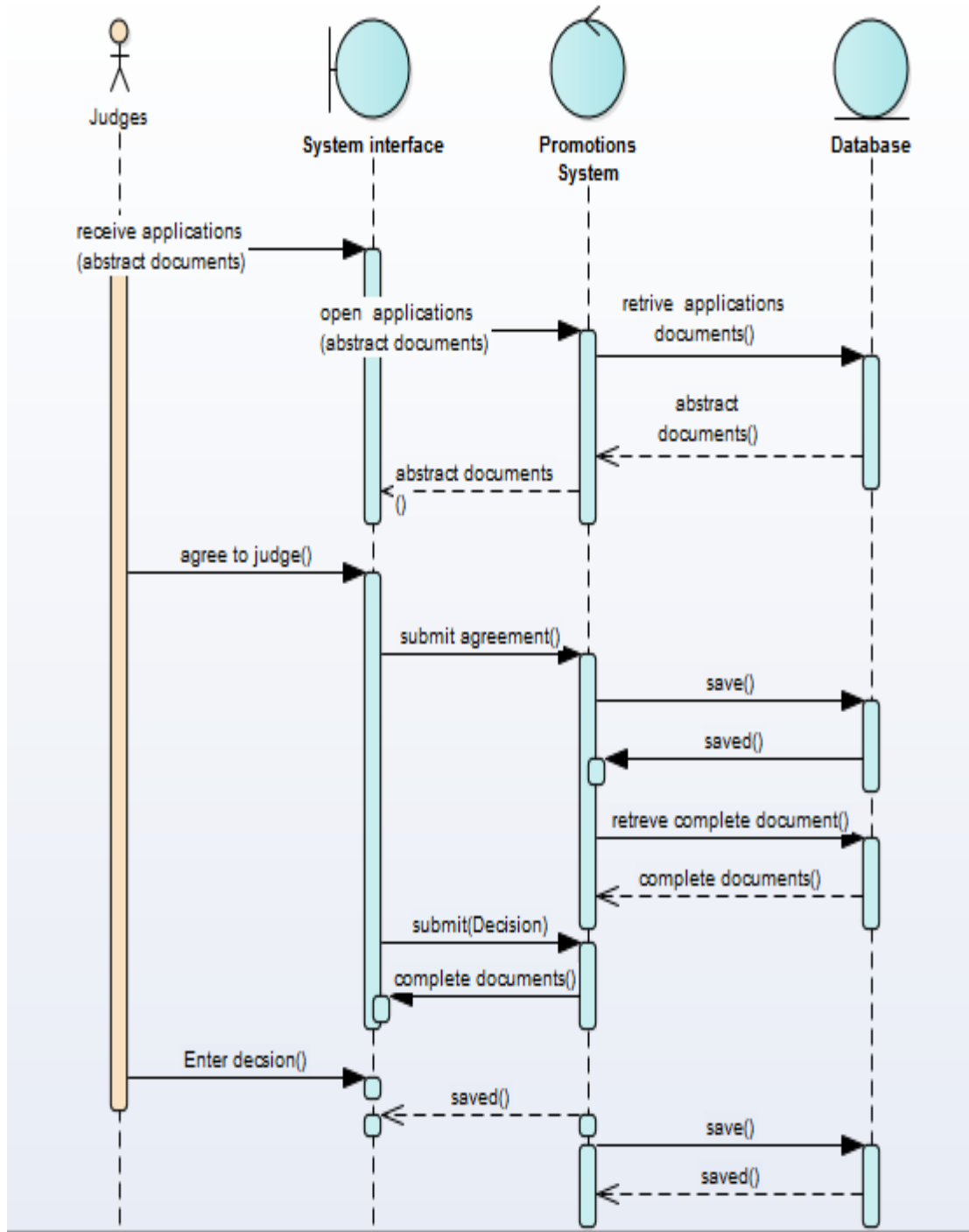
Figure [16] Small Promotion Committee Sequence Diagram

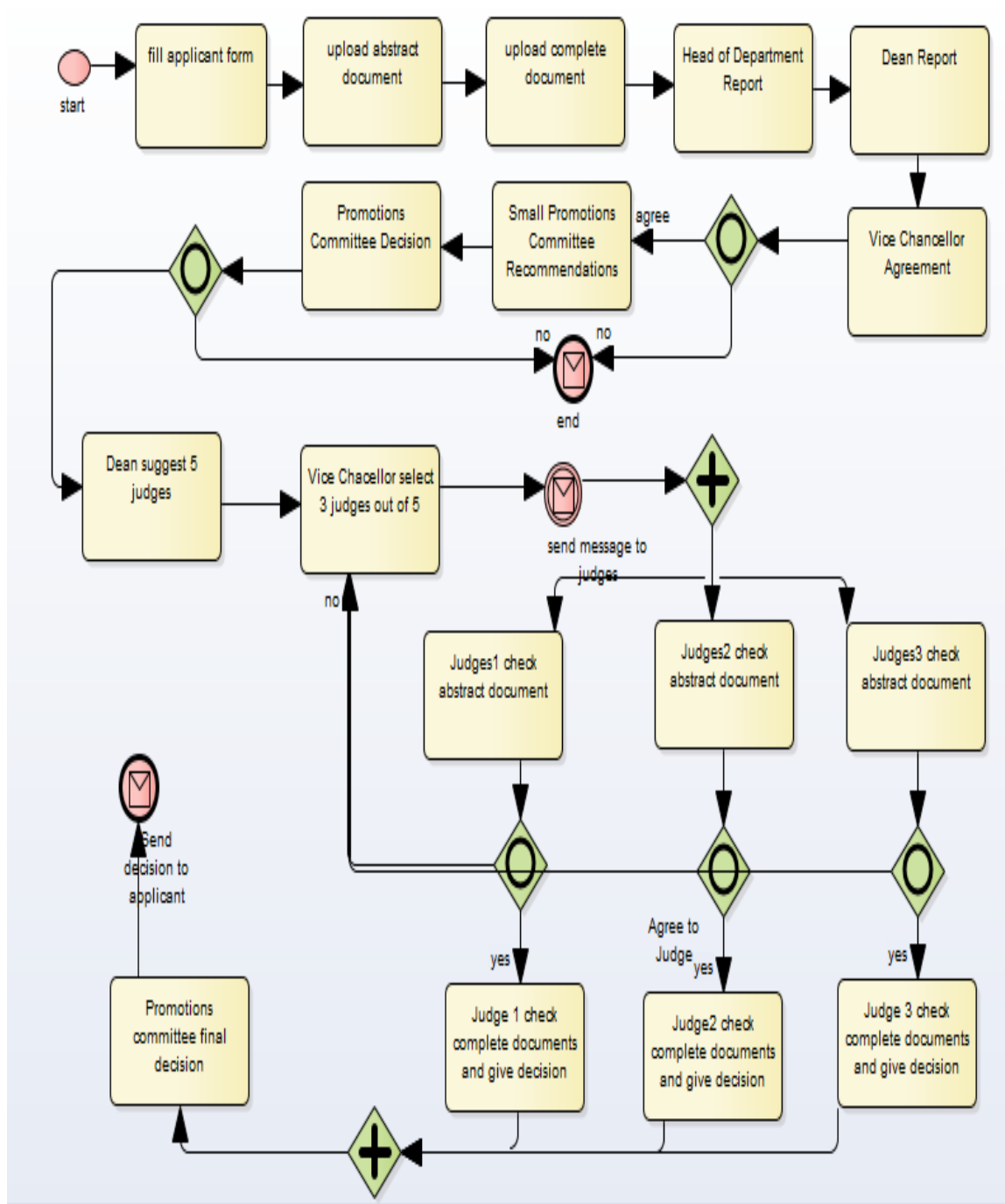**Figure [17] Judges Sequence Diagram**

4.4.4 BPMN Diagram

Figure [18] Academic Staff Promotion Application System BPMN Diagram

4.5 Implementation

For the system described in the previous section two systems have been developed and implemented using Joget and ProcessMaker. After implementing the system the research compare the two systems using the comparison framework.

4.5.1 Joget

Academic staff promotion system has been developed by Joget as case study. The researcher started the development of the workflow system with creating new application then designing workflow process by lunch workflow designer then opens the workflow designer and start designing by adding participants, activities, decisions and variables. By selecting deploy workflow designer will close and back to the Joget workspace. Then the researcher created users and forms. Mapped users to participants, forms to activities and mapped tools to plugins. Finally create data list and user view.

4.5.2 Joget framework result

After implementing the framework on Joget the research found that in the WfMC reference model Joget system is completely conformal to the WfMC reference model specifications. In functional areas Joget documentation provided by the developers is comprehensive, describing in detail each step of the installation and allowing us to install the software without facing any major problems. In fact, the installation of the software was simple. This workflow system provides a web based administration/client application that is very user friendly and easy to use. In order to work properly, Joget system installation requires the installation of java JDK. This system is compatible with a middleware platform SOAP. The database is Enterprise MySQL which allows extraction, transformation and execution of SQL statements via MySQL connector. It allows exceptions treatment during process execution. Using the graphical editor provided, which is web-based. The graphical editor provided by Joget is not web-based. The definition of our sample process was simple. In fact, the process definition editor uses a small set of elements to design a process, simplifying its analysis.

It is also based on a "drag and drop" idea. This situation makes it easier to add or to edit elements of the flow diagram. It also supports user organizational perspective. Joget implements the Workflow Management Coalition's XPDL (XML Process Definition Language). It is also provide user view which allows us to design graphical user interface to the system. However, one of the major drawbacks of this workflow solution is t in Email server; it's only to send email message to targeted recipient(s) through a set of primary and secondary SMTP servers. Joget support the parallel task, task can be sequential or parallel. Variables only used for decisions.

4.5.3 ProcessMaker

Academic staff promotion system has been developed by processMaker as case study. The researcher started the development of the workflow system with creating new application then designing workflow process by lunch workflow designer then opens the workflow designer and start designing by adding participants, activities, decisions and variables. By selecting deploy workflow designer will close and back to the Joget workspace. Then the researcher created users and forms. Mapped users to participants, forms to activities and mapped tools to plugins. Finally create data list and user view.

4.5.4 Processmaker framework result

After applying the framework on ProcessMaker the research found that in WfMC reference model ProcessMaker is fully compliant to the WfMC reference model specification. In Fictional Areas ProcessMaker documentation provided by the developers is comprehensive, allowing us to install the software without facing any major problem. its web based user interface. ProcessMaker requires the installation of java JDK. It works upon the middleware platform, Java Message Service, in order to exchange data and events. ProcessMaker offers an easy integration with most database management systems. It also supports exceptions treatment and rollback during process execution. The graphical editor provided by ProcessMaker is web-based. We have found a great amount of documentation about this process editor. It supports the definition of the organizational

model, allowing for the specification of participants and roles. ProcessMaker implements the Workflow Management Coalition's XPDL (XML Process Definition Language). It is also support parallel task. However, one of the major drawbacks of this workflow solution is that it does support the user view. No user interface can be design. This tool can send Email to predefine target participants ant and also can send to non participant from variable. Variables are used to store and retrieve data and also used for decisions.

4.6 Comparison Result and Discussions

After the systems have been implemented, the research compared the two systems using the comparison framework. The result shows that in WfMC reference model both tools are fully compliant to the WfMC reference model specification. In Fictional Areas, Documentation in both tools is comprehensive and installation and utilization of both tool is simple. Also both tools are web based and require java JDK. Both tools support middleware platform and DBMS integration. In transaction support, Joget support acceptations handling and rollback while processMaker only support rollback. Both tools are simple in the Process Definition and support organizational perspective. Also both tools implement the Workflow Management Coalition's XPDL. Joget does not support parallel task while peocessMaker does. Joget provide user view which allows us to design graphical user interface while processMaker doesn't provide it. In Email server Joget send email message to targeted recipient(s) through a set of primary and secondary SMTP servers while processMaker send email message to targeted recipient(s) and also can send Email from variable. In variables Joget used it in decisions while in processMaker used for storing and retrieving data and for decisions.

Comparison Framework		Joget	ProcessMaker
WfMC Reference Model Interfaces	Process Definition Application (Interface 1)	Support the Process Definition Application	Support the Process Definition Application
	Workflow Client Application (Interface 2)	Support the Workflow Client Application	Support the Workflow Client Application
	Invoked Applications (Interface 3)	Support the Invoked of Applications	Support the Invoked of Applications
	Other Workflow Enactment Services (Interface 4)	Support Other Workflow Enactment Services	Support Other Workflow Enactment Services
	Administration and Monitoring tools (Interface 5)	Support Administration and Monitoring tools	Support Administration and Monitoring tools
Functional Area	Research Scope	Support Research Scope	Support Research Scope
	Documentation	Comprehensive	Comprehensive
	Platform Independent	Yes it works in any platform	Yes it works in any platform
	Easiness of Installation and Utilization	Installation and Utilization are Simple	Installation and Utilization are Simple
	Web Based	It's a Web Based tool	It's a Web Based tool
	Other software required	Yes it required java to be install first	Yes it required java to be install first
	Middleware Platform	It need Middleware Platform	It need Middleware Platform

DBMS Integration	DBMS Integration is Comprehensive it's work with all DBMS	DBMS Integration is Comprehensive it's work with all DBMS
Transactions Support	Support Expiation handling & rollback	Only Support rollback
Easiness of the Process Definition	The Process Definition is Simple	The Process Definition is Simple
Organizational Perspective	Workflow system user can be individual, team, or organization	Workflow system user can be individual, team, or organization
Workflow Language	Workflow Language used in this tool is XPDL	Workflow Language used in this tool is XPDL
Parallel Task Support	Task can be Parallel or sequential	Task can be Parallel or sequential
User views	This tool support the design of graphical user interface and has a number of theme to choose from them	This tool doesn't support the design of graphical user interface it has only one look.
Email server	Email can be send only to a Predefined target participant(s)	Email can be send to a Predefined target participant(s) and can be send from variable enter by the users.
Variables	Variable only used in decision	Variable used for decision and to store and retrieve data

Table [2] the Comparison Framework result

5. Conclusion and Future work

5.1. Conclusion

The result shows that:

- In WFMC reference model both tools are fully compliant to the WFMC reference model specification.
- In Fictional Areas, Both tools have comprehensive documentation,
- Both tools have a simple installation and utilization.
- Also both tools are web-based.
- Both tools require java JDK.
- Both tools support middleware platform.
- Both tools support DBMS integration.
- Process Definition in both tools is simple.
- Both tools have comprehensive organizational perspective.
- In transaction support, joget support expiation handling and rollback while processMaker only support rollback.
- Joget and processMaker supports parallel task.
- Joget provide user view which allows us to design graphical user interface while processMaker doesn't provide that.
- In Email server joget send email message to a predefined targeted recipient(s) through a set of primary and secondary SMTP servers while processMaker send email message to a predefined targeted recipient(s) and can send Email from a value that is enter by users in executions time.
- In variables joget only uses variables in decision while processMaker use it in decision, storing data and retrieve data from forms.

5.2. Future Work

- This research only compares two tools. More work can be done to compare more than two tools.
- The comparison framework used in this research functionality oriented comparison. Complete comprehensive framework can be developed.

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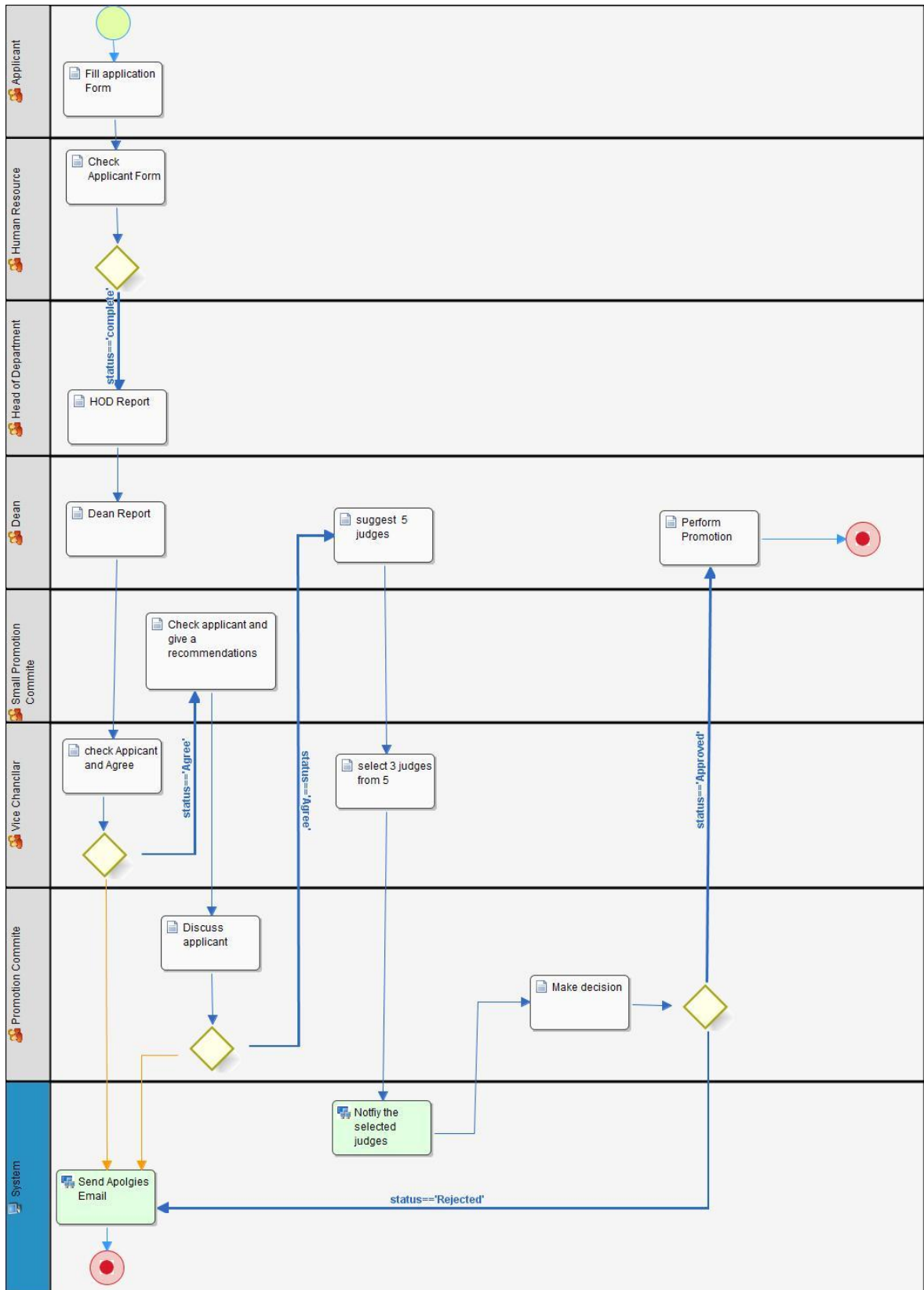
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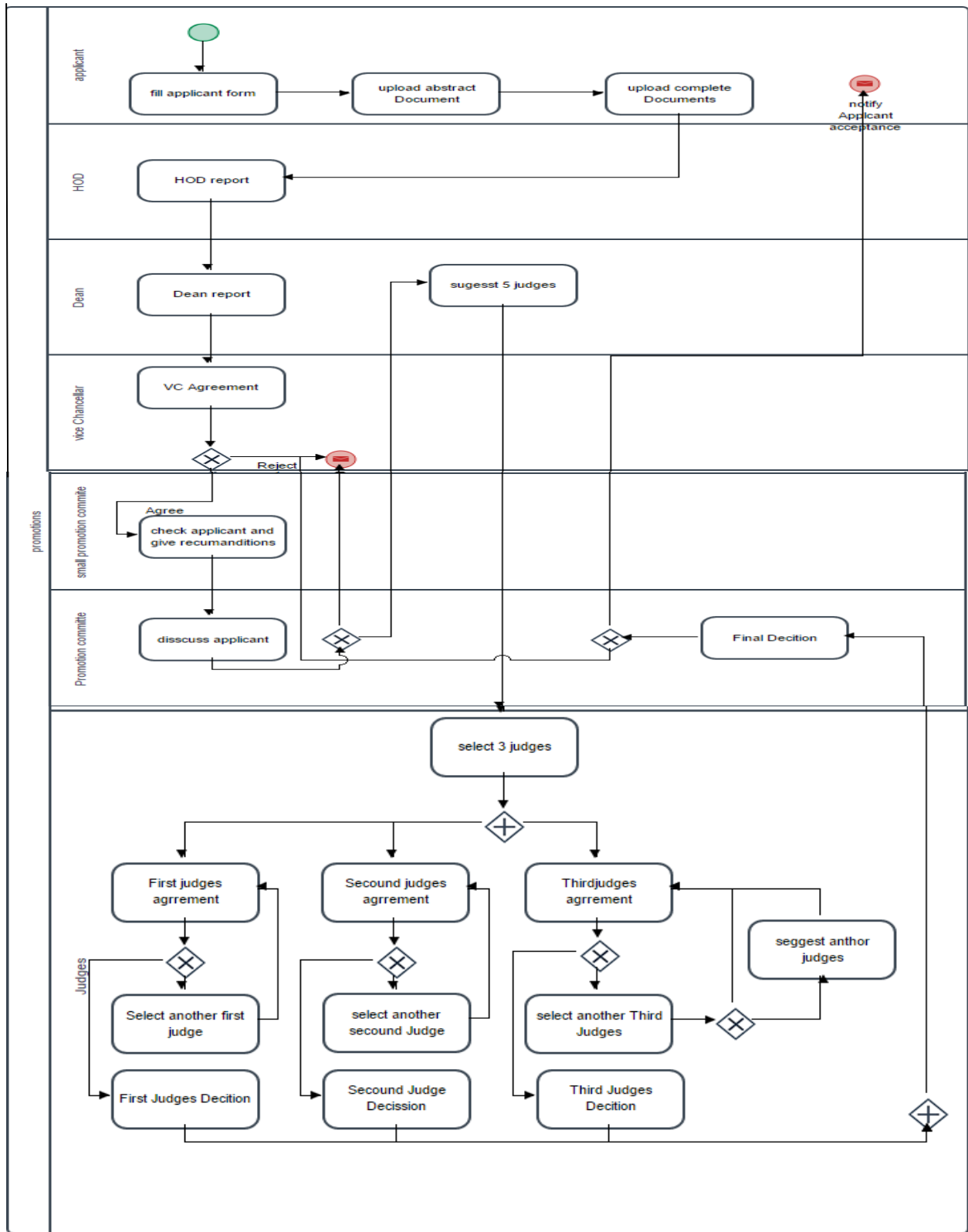**Figure [19] Academic Staff Promotion Application System Process in Joget**

Figure [20] Academic Staff Promotion Application System Process in ProcessMaker