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**A comparative study between two workflow Tools
management systems Case study (Joget, Bonita)**

دراسة مقارنة بين اداتين لإدارة أدوات سير العمل (Joget , Bonita)

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قال تعالى

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

الآية ﴿32﴾ سورة البقرة

Dedication

All praise to Allah, today we fold the days' tiredness and the errand summing up between the cover of thishumble work.

To the utmost knowledge lighthouse, to our greatest and most honored prophet Mohamed (May peace and grace from Allah be upon him)

To the Spring that never stops giving, to my motherwho weaves my happiness with strings from her merciful heart... to my mother.

To whom he strives to bless comfort and welfare and never stints what he owns to push me in the success way who taught me to promote life stairs wisely and patiently, to The spirit of my dear father Oh God, descend on the grave of light and light and pleasure and permission of charity is charity and the afflictions forgiveness and mercy.

To I have made the most of my difficulties to be happy for you all thanks to my dear wife.

To I have a liver and my daughters are Sweethearts.

To whose love flows in my veins, and my heart always remembers them, to my brothers and sisters.

To those who taught us letters of gold and words of jewel of the utmost and sweetest sentences in the whole knowledge. Who reworded to us their knowledge simply and from their thoughts made a lighthouse guides us through the knowledge and success path, To our honored teachers and professors.

ACKNOWLEDGMENTS

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I would like to extend my sincere thanks to the University of Sudan for Science and Technology (SUST) for its enlightening efforts. I would also like to thank Dr. Mohammed Elhafiz Mustafa Musa, who has been very kind to me for the guidance and advice.

I would also like to thank all those who helped complete this work.

Researcher

Abstract

It is difficult to choose the performance of a workflow management system because of the multitude of tools. This research provides a framework for comparing two tools of workflow systems (Joget, Bonita) in order to find the best one, The goal is to design framework that helps developers to the appropriate tool for a given task . The descriptive analytical approach (data collection and analysis) was followed and the proposed framework for comparing popular workflow tools, Joget and Bonita. It is found that Bonita is better in terms of multiple users and users Management. While Joget provides only three users, Bonita provides forms generation and database management. Joget generates forms one by one.

المستخلص

ان من الصعب اختيار أداء لنظام إدارة سير تدفق العمل بسبب تعدد الأدوات. ويوفر هذا البحث إطارا للمقارنة بين اثنين من أدوات أنظمة سير العمل (Joget , Bonita) من أجل العثور على أفضل واحد، والهدف من ذلك هو تصميم إطار قبعة يساعد المطورين على الأداة المناسبة لمهمة معينة . وقد تم اتباع المنهج الوصفي التحليلي (جمع البيانات وتحليلها) ثم استخدام الإطار المقترح لمقارنة أدوات سير العمل شعبية وهي Joget و Bonita وقد وجد أن الـ Bonita أفضل من حيث تعدد المستخدمين وإدارة المستخدمين (User Management) . بينما الـ Joget يتيح ثلاثة مستخدمين فقط ، و يوفر الـ Bonita عملية توليد النماذج (Forms) وإدارة قواعد البيانات (Database) اما الـ Joget يتم بناء النماذج الـ (Forms) حقل تلو الآخر.

List of Abbreviations

WF	Workflow
WFMS	Workflow management system
BP	Business Process
BPM	Business Process Modeling
BPMN	Business Process Modeling Notation
HTTP	Hypertext Transfer Protocol
API	Applications programming Interface
WFMC	Workflow Management Coalition
XPDL	XML Process Description Language

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Chapter One

Introduction

Chapter One

Introduction and Problem Statement

1.1 Introduction

Workflow is 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]. A workflow management system is a computer system that manages and defines a series of tasks within an organization to produce a final outcome or outcomes. Workflow management systems allow the user to define different workflows for different types of jobs or processes[1]. Workflow management systems also automate redundant tasks and ensure that uncompleted tasks are followed up. There are many workflow tools with different capability .however, there are no standard method to compares them. These thesis aims Implementing the academic staff promotion system on two tools of the workflow. The work is case study base approach .the proposed framework will be tested on comparing to workflow system generated by two different tools.

1.2 Problem Statement

There is no standard method for workflow tools comparison. It is hard to know which tool is the best to the intended system. This thesis aims to Implementing the academic staff promotion system at the Sudan University of Science and Technology on two tools of the workflow to compare them.

1.3 Research Objectives

- Implementing the academic staff promotion system on two tools of workflow management. For comparison.
- Determine which tools are best in terms of design, analysis and implementation

1.4 Methodology

The research methods for this study include Analytical Descriptive Approach (where data and forms were collected and analyzed) and a literature review; a method for comparing two tools will be developed and used to compare the two selected tools. The method will be a case study based one. Therefore, a case study were develop and used in comparing these two tools (joget, bonita) .

1.5 Thesis Organization

This thesis contains four chapters. Chapter one is an introduction. Chapter Two, is workflow definitions and systems, this chapter discusses general terms of business process and workflow, workflow architecture, and used tools overview. Chapter Three is workflow comparison, which discusses comparison framework. describes the case study and the systems developed for the case study using Joget and Bonita, also include the comparison results. Chapter Four describes the Research Results, and Recommendation.

Chapter Two
Literature Review

Chapter Two

Literature Review

2.1 Introduction

This chapter reviews and explains, the background of the concept of Workflow and Workflow Management Systems (WFMS) and definition of Business Process. The chapter contains a detailed description of two Business Process Management System (BPMS) tools Bonita and Joget to illustrate the architecture of each one and how it work.

2.2 Workflow

Workflow is concerned with the automation of procedures where documents, information or tasks are passed between participants according to a defined set of rules to achieve, or contribute to, an overall business goal. Whilst workflow may be manually organized, in practice most workflow is normally organized within the context of an IT system to provide computerized support for the procedural automation and it is to this area that the work of the Coalition is directed[2].

Workflow is often associated with Business Process Re-engineering, which is concerned with the assessment, analysis, modelling, definition and subsequent operational implementation of the core business processes of an organization (or other business entity). Although not all BPR activities result in workflow implementations, workflow technology is often an appropriate solution as it provides separation of the business procedure logic and its IT operational support, enabling subsequent changes to be incorporated into the procedural rules defining the business process. Conversely, not all workflow implementations necessarily

form part of a BPR exercise, for example implementations to automate an existing business procedure [2].

2.3 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]. Workflow management systems support the definition and administration of workflow types (at design time) as well as the execution and monitoring of workflow instances (at run time). We distinguish between autonomous and embedded workflow management. This is again similar to database management systems, which might also operate as (autonomous) standalone systems or as (embedded) components of information systems. Autonomous workflow management is based on a standalone workflow management system. Embedded workflow management means that a workflow engine and other system components are integrated in an information system [4].

2.4 Business Process

We use the term "business process" to refer to a conceptual way of organizing work and resources in this sense; a business process is not tangible. However, product instances are produced by executing or instantiating the business process. A business process execution involves real people, materials, clients, machines, computers, and delivers one or more actual products. In this sense, the execution is the actual manifestation of a business process [5].

2.5 Business Process Management

Business Process Management (BPM)- is a way of looking at and then controlling the processes that are present in an organization. It combines technical tools and management discipline to improve how is work done, resulting in highly automated processes that help people provide better products and service and deliver better business results[1].

The resulting definition is sometimes called a process model, a process template, process metadata, or a process definition [17].

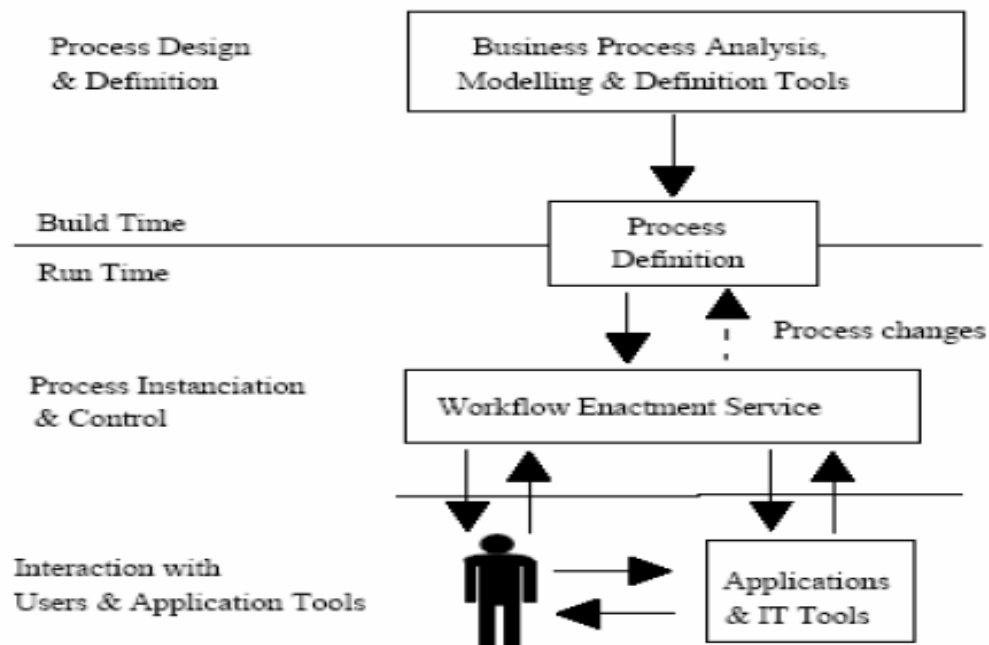


Figure [2.1]: Workflow System Characteristics [6].

2.6 Related concepts

The concept of workflow is closely related to several fields in operations research and other areas that study the nature of work, either quantitatively or qualitatively, such as artificial intelligence (in particular, the sub-discipline of AI planning) and ethnography. The term workflow is more commonly used in particular industries, such as printing and professional domains, where it may have particular specialized meanings[6].

2.6.2 Planning and scheduling

A plan is a description of the logically necessary, partially ordered set of activities required to accomplish a specific goal given certain starting conditions. A plan, when augmented with a schedule and resource allocation calculations, completely defines a particular instance of systematic processing in pursuit of a goal. A workflow may be viewed as an (often optimal or near-optimal) realization of the mechanisms required to execute the same plan repeatedly.

Flow control is a control concept applied to workflows, to distinguish from static control of buffers of material or orders, to mean a more dynamic control of flow speed and flow volumes in motion and in process. Such orientation to dynamic aspects is the basic foundation to prepare for more advanced job shop controls, such as just-in-time or just-in-sequence.

In-transit visibility is a monitoring concept that applies to transported material as well as to work in process or work in progress, i.e. workflows.

2.8 Workflow Components

A workflow can usually be described using formal or informal flow diagramming techniques, showing directed flows between processing steps. Single processing steps or components of a workflow can basically be defined by three parameters:

1. input description: the information, material and energy required to complete the step
2. transformation rules: algorithms which may be carried out by people or machines, or both
3. output description: the information, material and energy produced by the step and provided as input to downstream steps.

Components can only be plugged together if the output of one previous (set of) component(s) is equal to the mandatory input requirements of the following component. Thus, the essential description of a component actually comprises only in- and output that are described fully in terms of data types and their meaning (semantics). The algorithms' or rules' descriptions need only be included when there are several alternative ways to transform one type of input into one type of output – possibly with different accuracy, speed, etc.

When the components are non-local services that are invoked remotely via a computer network, such as Web services, additional descriptors (such as QoS and availability) also must be considered.

After reviewing the previous studies comparing the two tools Bizagi and Joget found that the researcher “This research compared two Workflow Management System BizAgi (academic version it support all features but only for ten users) and

Joget (Community Edition is available free under the open source General Public License (GPL). As this edition is unsupported, it is intended for enthusiasts and developers and not resolving issues independently). The research was focused on the Process Modeling, Monitoring, Process Engine and Business Activity Monitoring. The research show that the BizAgi tool has satisfactory performance during development, as it was quite easy to develop the case study.” [18]

The researcher also found in another study comparing between Bonita and OpenKM and Talend ESB “Three open sources were examined: OpenKM, Bonita and Talend ESB. OpenKM and Bonita were found to be not free of charge, since they highly charge their costumers for essential team training and for buying a startup package for the production phase. Moreover, they only respond to queries of ubscribed costumers previously paid for their subscription. Talend ESB was chosen among the others because of its advantage of providing ability for writing codes during product customization. Finally, the research ended by implementing and successfully testing ESB in a pioneer company after setting up the integration environment and using an appropriate search engine.” [19],The researcher is now comparing the tools Bonita and Joget

2.9 Workflow Tools

2.9.1 Introduction

This section describes two workflow management system tools (Joget , Bonita) describing the properties and features of this tool.

2.9 .2 Joget workflow

Joget Workflow is a workflow management system that serves as an open source platform to easily build enterprise web apps, Joget offers full-fledged agile application development capabilities (consisting of processes, forms, lists, CRUD and UI), With a comprehensive plug-in architecture, developers are also able to easily extend the platform and integrate Joget Workflow with other systems whenever required, Joget Workflow For Developers and IT Professionals (see Figure 2.2) .

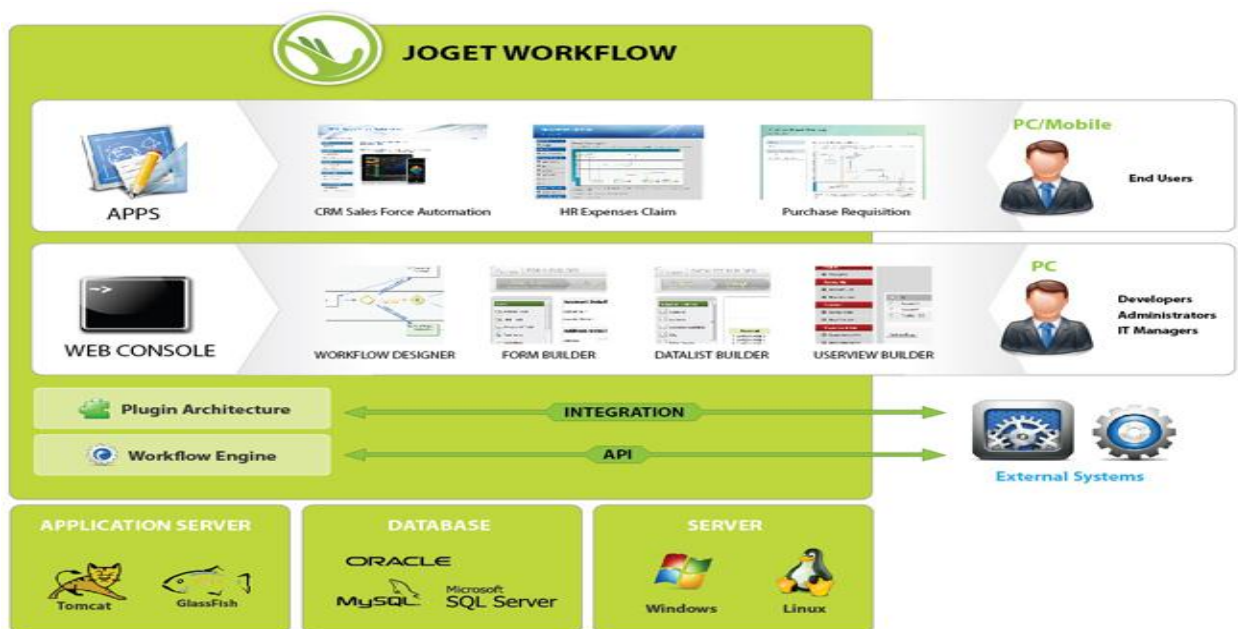


Figure [2.2]: Joget Workflow System Components [13].

2.9.2.1 Workflow Engine

The Workflow Engine is the heart of the system which executes processes deployed from the Workflow Designer. Supporting the XPDL 1.0 standard, the Workflow Engine allows for easy integration to external systems by providing a simple HTTP-based API along with Java and JavaScript libraries.

Once the process has been designed, processes are deployed and configured by mapping the activities with participants, forms and tools using the Workflow Management Console. Once the mapping is completed, the users can start and run the process to perform the tasks. The Process cycles can be repeated and each process is versioned using the version control feature [7].

2.9.2.2 Web Console

The Web Console is a web-based interface for Administrators and App Designers to (see Figure 2.3) :

- All apps .
- Users .
- Monitor .
- Settings .



Figure [2.3]: Workflow Management Console Menu [13].

2.9.2.3 Workflow Designer

Workflow Designer is a graphical tool which allows Process Designers or Business Analysts to create visual process flows based on their business processes (see Figure 2.4).

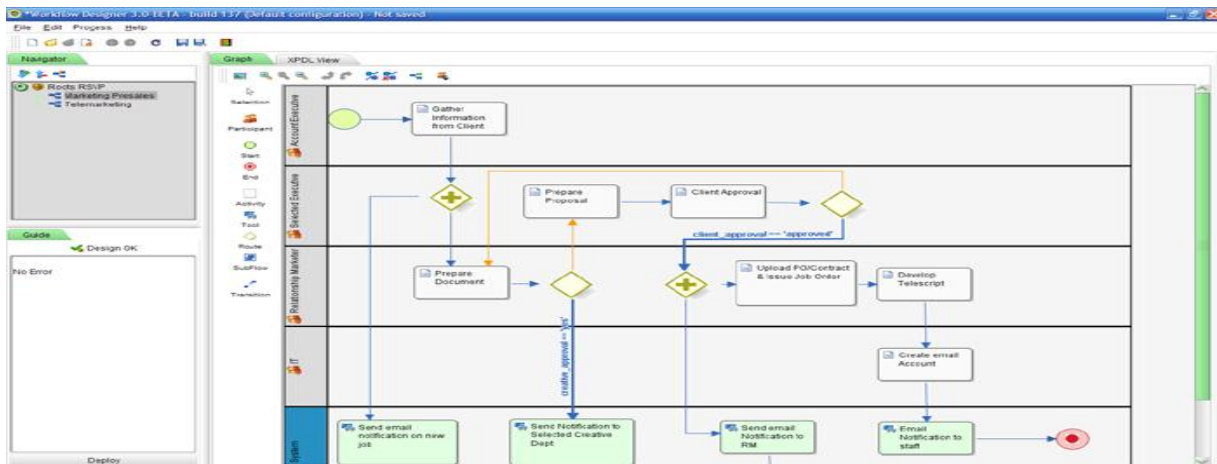


Figure [2.4]: Workflow Designer [13].

Once the process is designed, the design can be automatically deployed to the Workflow Engine directly from within the Workflow Designer, or saved as an XPDL file before uploading it. If there is an existing XPDL file

2.9.2.4 Form Builder

The Form Builder makes it easy for the designers to design and manage forms to be used by end users to perform their task. one can easily build a form by using the simplistic and guided interface, the forms can be designed and edited using the form builder tool. where you can mapped the forms that are completed to the activities defined in the workflow (see Figure 2.5) .

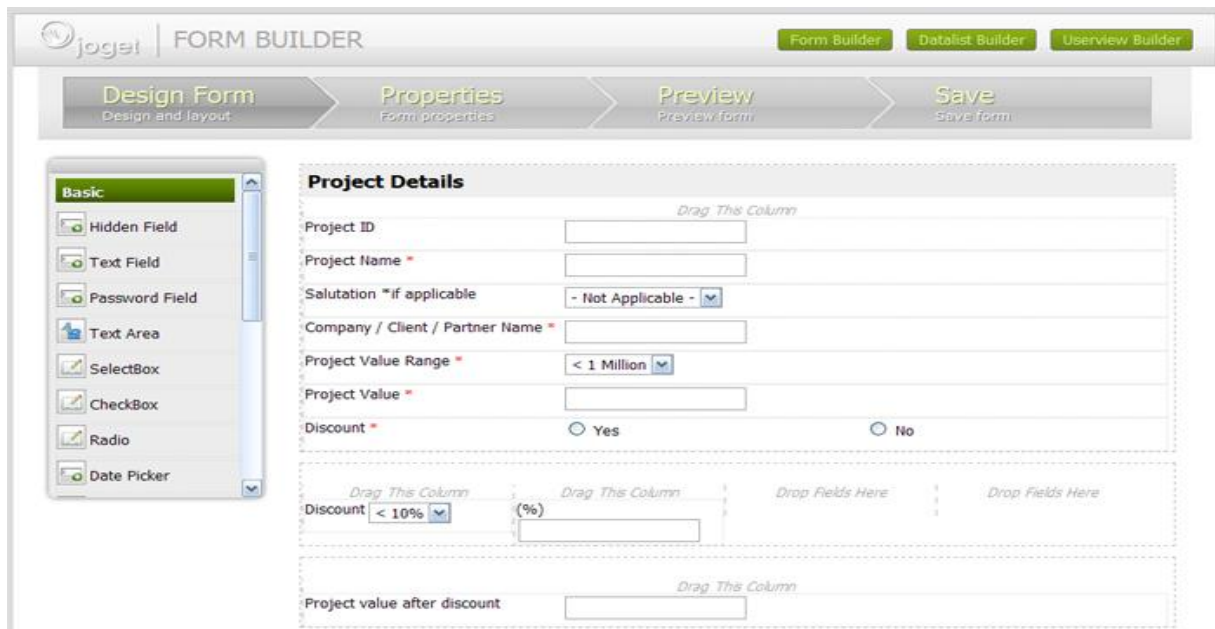


Figure [2.5]: Form Builder [13].

2.9.2.5 Data list Builder

The Data list Builder offers an intuitive way of constructing a list of cumulative field values from all workflow process instances associated with the

selected form. In other words, any time a user fills out a form, a row is added/updated in the database table associated with that form, and the data is presented in a Data list, each data list can be customized not only in display but also in the method of sort and filter as well as the actions available to the end user within that list (see Figure 2.6).

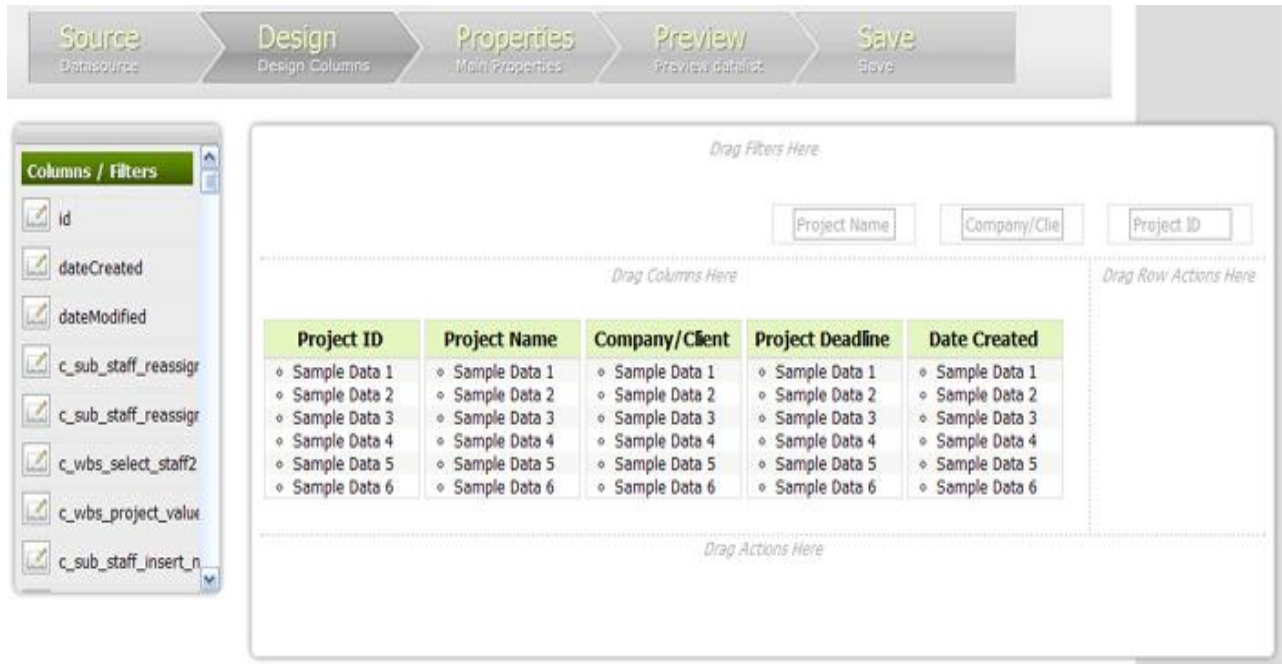


Figure [2.6]: Data list Builder [13].

2.9.2.6 Userview Builder

Userview Builder lets you design the front-end interface in a matter of minutes. You may choose from the list of preloaded themes, or you may develop your own theme. Front-End Admin Bar allows the administrator to easily locate and manage elements created from the published Userview itself. In a Userview, menus are contained in Userview Category. In a Userview Category, one may manage its permission.

Userview Builder Features(Additional Userview Themes ‘Advanced CRUD Userview Menu ‘CSV Import Userview Menu ‘Data list Inbox Userview Menu (Inbox with Form Data) ’ SLA Report Userview Menu , SQL Chart Userview Menu ‘ Universal Inbox Userview Menu ‘ User Profile Userview Menu) (see Figure 2.7).

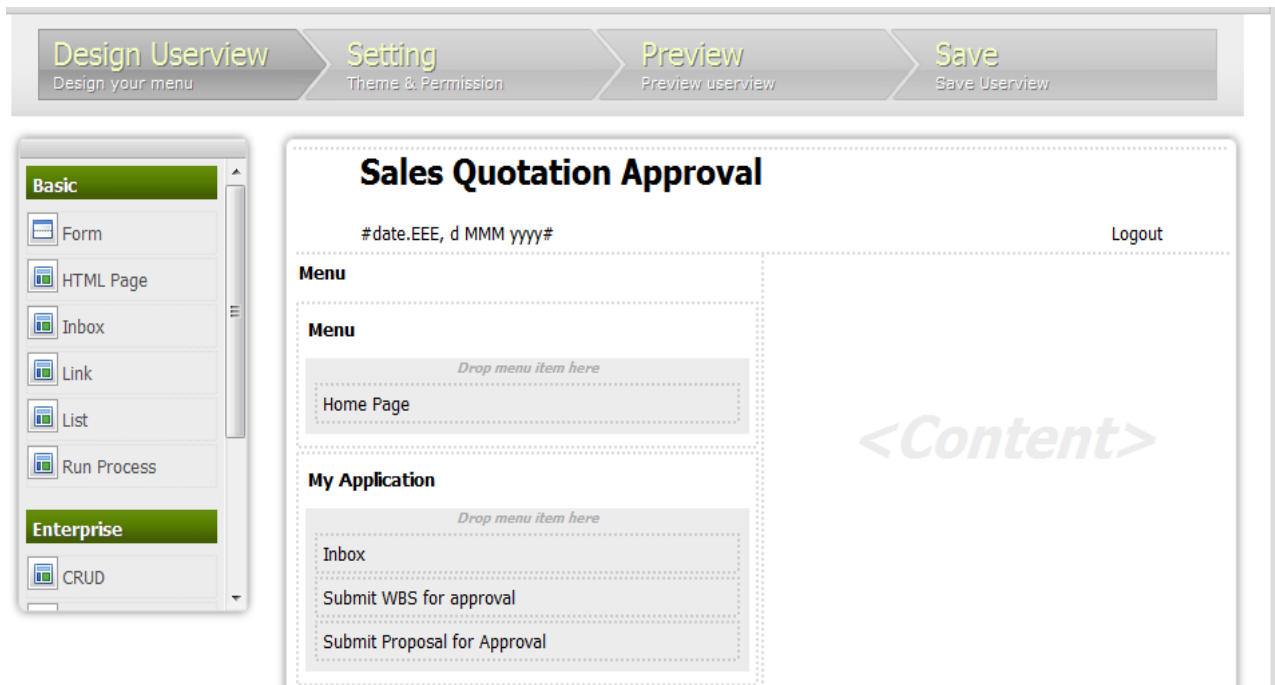


Figure [2.7]: Userview Builder [13].

2.9.2 Bonita

Bonita BPM is an open-source business process management and workflow , Bonita consists of three basic components (Bonita Studio, Bonita BPM Engine, Bonita Portal)

2.9.2.1 Bonita Studio

It allows the user to graphically modify business processes following the BPMN standard. The user can also connect processes to other pieces of the information system (such as messaging, enterprise resource planning, enterprise content management, and databases) in order to generate an autonomous business application accessible as a web form. Bonita Studio also allows the user to design graphically the forms that will be shown to the end user in order to interact with the process (see Figure 2.8) .

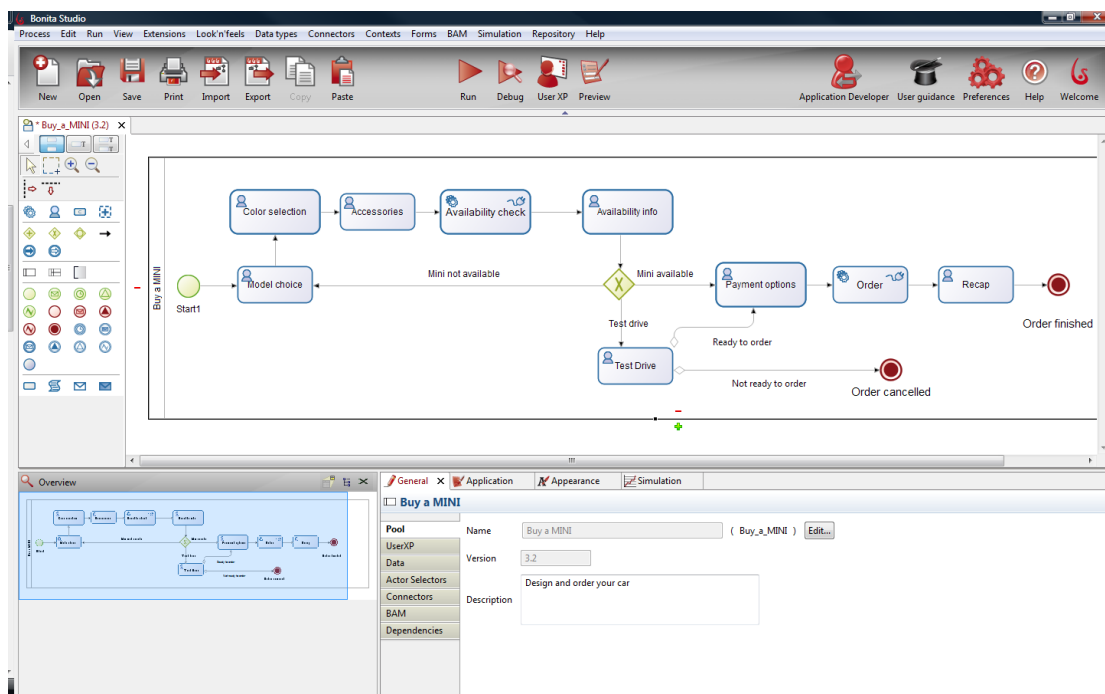


Figure [2.8]: Bonita Studio [14].

2.9.2.2 Bonita BPM Engine

The BPM engine is a Java application that executes process definitions created with Bonita Studio. Engine API allows the user to interact programmatically with his/her processes (see Figure 2.9) .

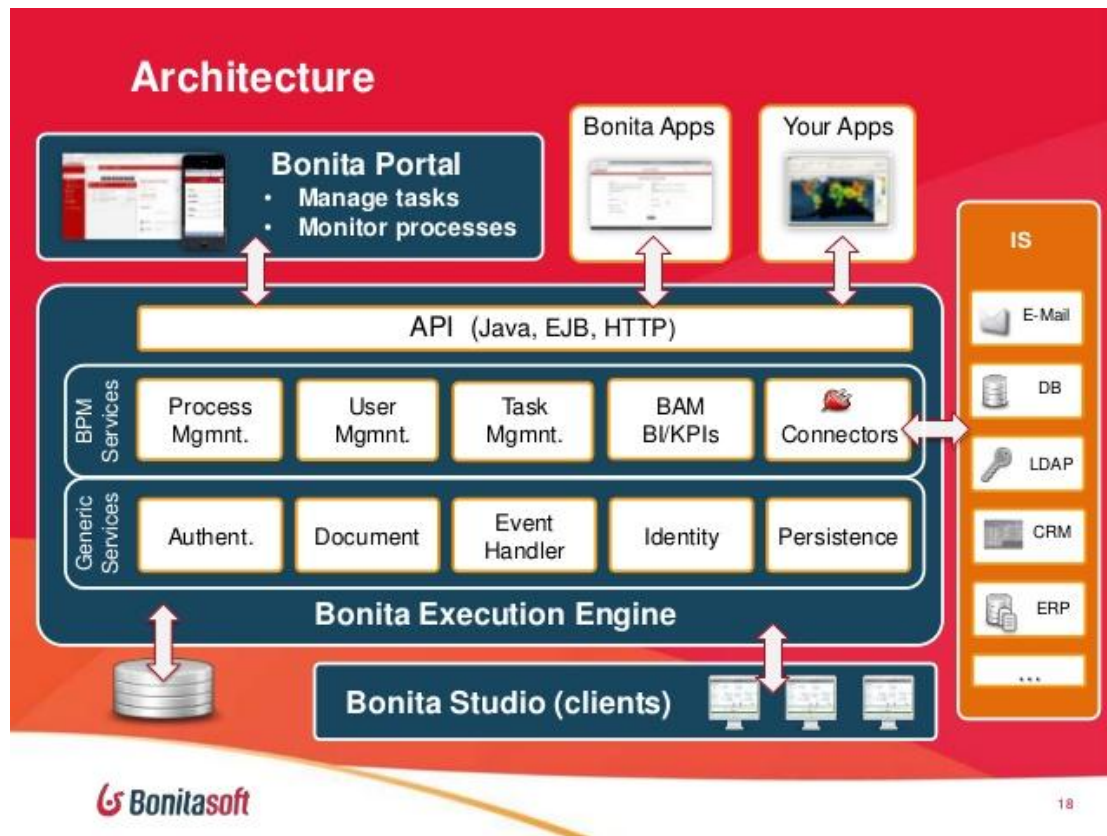


Figure [2.9]: Bonita BPM Engine [15].

2.9.2.5 Bonita Portal

It is a portal that allows each end-user to manage, in a webmail-like interface, all the tasks in which they are involved. The portal also allow the owner of a process to administer and to get reports about processes (see Figure 2.10).

Welcome: **Walter Bates** | Administrator | Settings

Process management | Organization | Analytics | Configuration | Applications

Search... [DO FOR] [MORE]

Pending

Failed

Done

Processes

New Leave Request 1.2

ASSIGN UNASSIGN

Create a new Leave Request

This step allows employees to create a leave request. The employees can see the available and applied leaves, cancel any applied leave by selecting the row from the applied leave list or create a new leave request

Case: 1 | Due date: in 56 min
 Process: New Leave Request | Type: Human task
 Assigned to: Walter Bates

Technical details

Ready since November 17, 2014
 Connectors to be executed: 0
 Connectors failed: 0
 Connectors executed: 0

Comments

System 3 min ago: The task "Create a new Leave Request" is now assigned to walter.bates

Type new comment [ADD COMMENT]

Figure [2.10]: Bonita Portal [16].

Chapter Three
Comparison Framework

Chapter Three

Comparison Framework

3.1 Introduction

This chapter presents the proposed comparative framework and analyzes this process and implements it on two tools of the Workflow Management System (joget and BonitaSoft) so that the administration in the institution can choose the best performance for accomplishing the required tasks and describe the promotion system of the professor at the Sudan University of Science and Technology as a case study.

3.2 The proposed Comparison Framework

Several approaches have been proposed to compare information systems and information technologies. Since workflow technologies have specific characteristics, existing approaches do not address many important perspectives [8]. Therefore, the research also wants to evaluate the capability of the selected tools. For this reason, the research will cover use the workflow process testing model to evaluate the capability of the selected tools and categorize the tools based on certain criteria.

3.3 Capability Criteria

The framework secondly use the workflow process testing model to evaluate the capability of the selected tools and categorize the tools based on certain criteria

such the availability of an analysis tool, tool features, vendor support, graphical editor, execution engine, simulation, user manual, and qualified tool.

3.3.1 Availability of an Analysis Tool

The degree to which a system, subsystem or equipment is in a specified operable and committable state at the start of a mission, when the mission is called for at an unknown, i.e. a random, time. Simply put, availability is the proportion of time a system is in a functioning condition [9]. The workfolw solution should have an analysis tool.

3.3.2 Tool Features

Workflows may be a simple sequence of work activities, or a complicated collection of processes that take place in parallel. When a company's methodology features workflow management system capability, the result can be more visibility into all stages of the process, better accountability among work team members, and improved efficiency overall. With the right workflow management solution, repetitive tasks can be automated, and better collaboration is facilitated. this feature like Easy Graphical Modeling of Processes, Access Control Based on Participant Responsibilities, Flexibility of Workflow Patterns, Option to Pre-Fill FormsEasy-to-Interpret, Visual Representation of Task Status, and The Convenience of Cloud Hosting[12].

3.3.3 Vendor Support

contributions of vendors and organisations showing how their system/language can implement the workflow patterns.

3.3.4 Graphical Editor Execution Engine

Workflow engine technology represents a new class of software with the ability to graphically model step-based knowledge.

3.3.5 Simulation

provide a workflow level support of simulation. Simulation is a process in which you validate and verify a model by comparing simulation results with Data collected from a real system and Functionality described in the model requirements. Perform the simulation workflow after you've finished building your model and a simulation completes without errors. The steps in a typical simulation workflow include Prepare for simulation and Run and evaluate simulation[11].

3.3.6 User Manual

Workflow tool should have a user manual describes how to use the tool and a full documentations of the tools.

3.3.7 Qualified Tool

The workflow Tool should be qualified according to the basic process.

capability criteria	Availability of an analysis tool
	Tool modeling features
	Vendor support
	Graphical editor
	Simulation Execution engine
	User manual
	Qualified tool

Table [3.1] the Comparison Framework.

3.4 Comparison Environment

For this thesis two of the 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 Bonita. All the WFMS analyzed were installed and tested in an Intel ® Core™ i3-2348M CPU @ 2.30GHz computer with 4.00 GB memory, System type 64-bit, 500GBdisk space and running Windows 10 Pro.

3.5 Case Study

3.5.1 Academic Staff Promotion Application System Description

Application promoted academic staff is a complex task which contain many of the participants in the application where it passes the following steps sequentially:

- The applicant will fill the promotion form and upload CV and certificates, scientific contributions and sent to the Human Resources Management .
- The HR management to review the basic data in the form and sent to the head of the department, which originates him Applicant .
- The head of the department to verify the data and private scientific contributions and send them to college dean
- The head of the department to verify the data and private scientific contribution and then write the report and send it to the Dean of the College
- The dean of the college to verify the data again to write a report and send it to the vice chancellor

- The vice chancellor checks the form and all attached documents and reports sent to him and then make a decision, if the decision was refused a request promotion the application to send an apology to the private applicant's e-mail, But in the case of the decision was to grant the request promotion the request is sent to the Committee on the mini promotions
- The Committee on the mini promotions to study and verify the authenticity of the documents specified in accordance with the scientific framework and then classifies the request in terms of completeness or not with the recommendations in writing about it and then send it to the committee promotions
- The Promotion Committee to discuss the request and make a decision in the case of the decision was rejected a request promotion the application to send a letter of apology to the private applicant's e-mail, But in the case of the decision was to grant the request promotion request is sent suggested arbitrators by Dean on and then send suggestions to the vice chancellor
- The vice chancellor selection of arbitrators for arbitration on scientific contribution
- Each arbitrator Viewing to the scientific contributions and make a decision in the case of the decision was rejected arbitration shall be notified Rector to choose an arbitrator Other, But in the case of the decision to accept arbitration arbitration is sending a report to the Committee on Promotions
- The Promotion Committee to discuss the three arbitrators reports and then make a final decision about the upgrade in case the decision was

refused a request promotion the application to send a letter of apology to the private applicant's e-mail, But in the case of accepting the request promotion is sending the decision to accept promotion human resources management to complete the proceedings and to make a letter upgrade to the applicant

3.5.2 Use Case Model

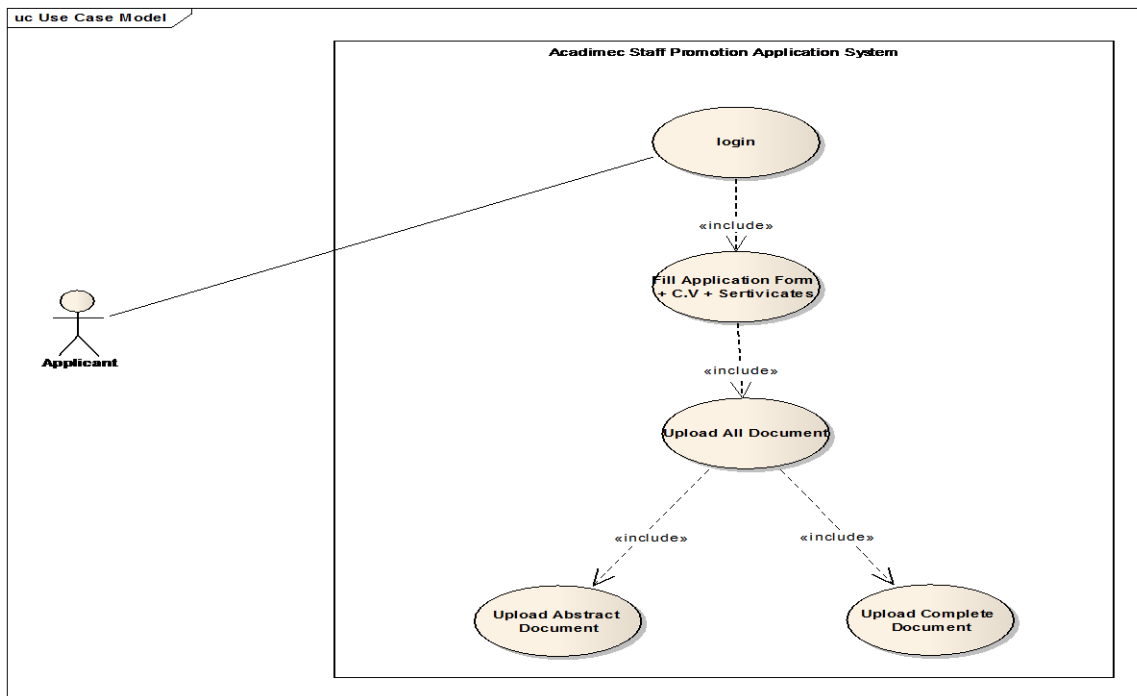


Figure [3.1] Applicant Use Case Diagram

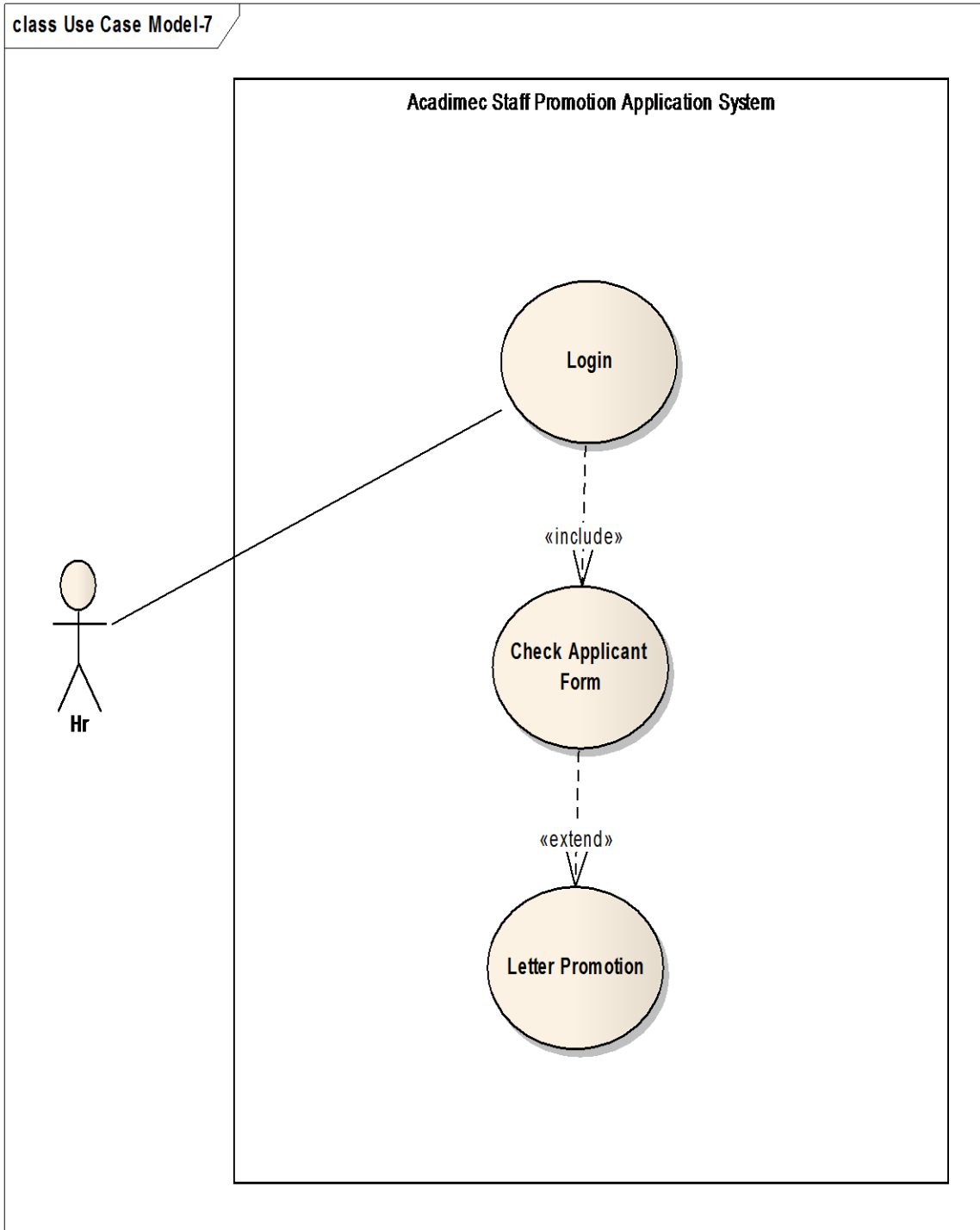


Figure [3.2] Human Rescore Use Case Diagram

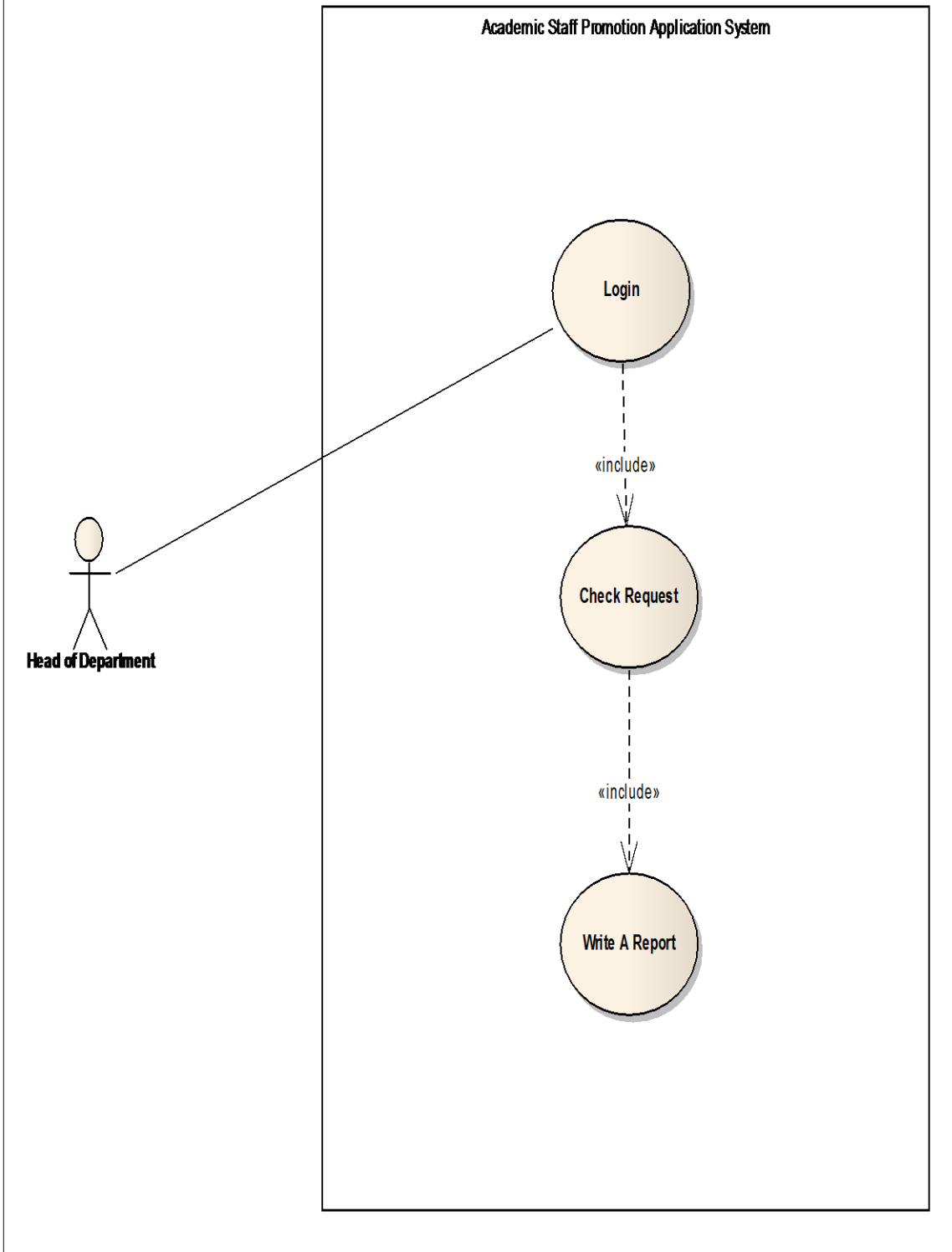


Figure [3.3] Head of Department Use Case diagram

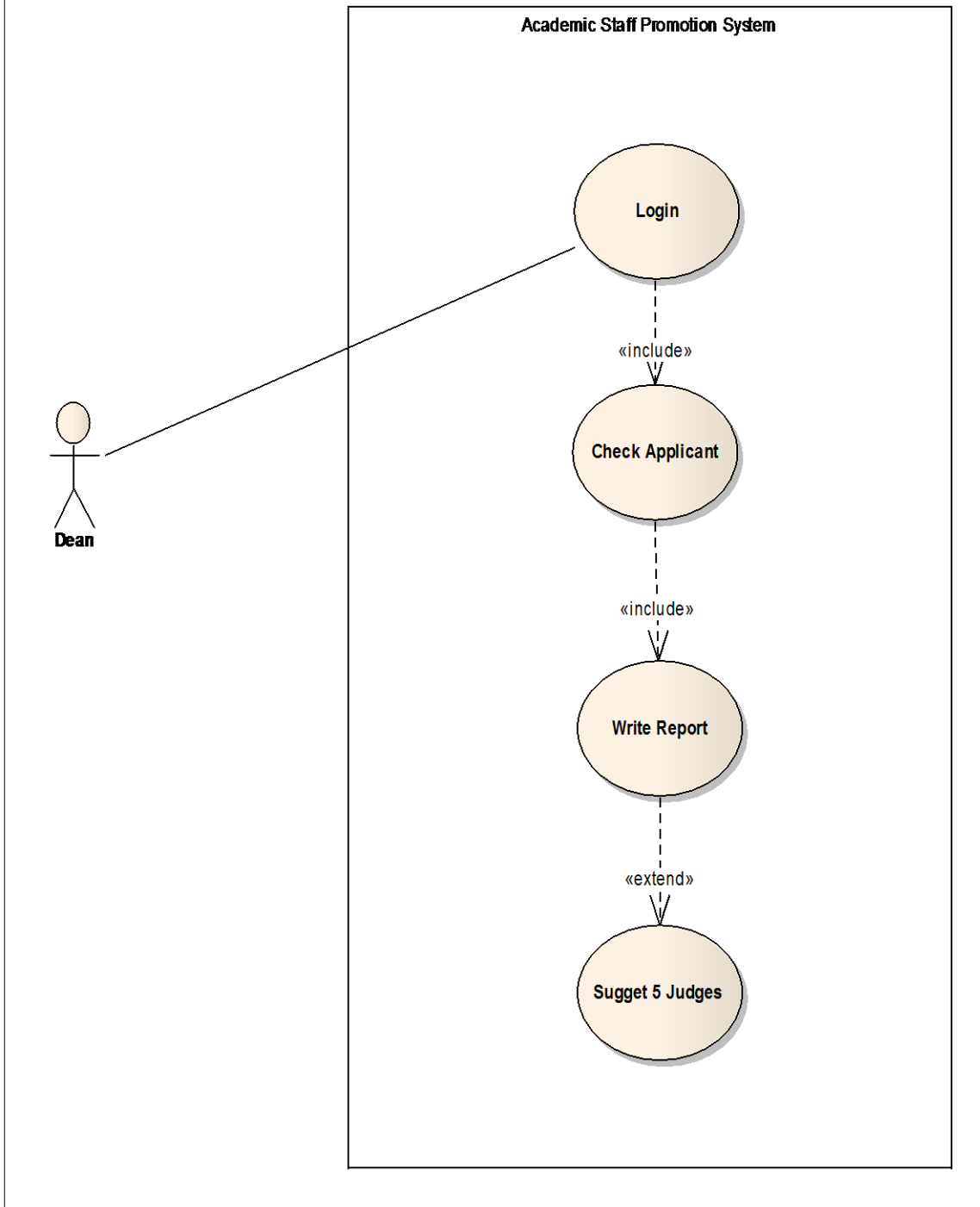


Figure [3.4] Dean Use Case Diagram

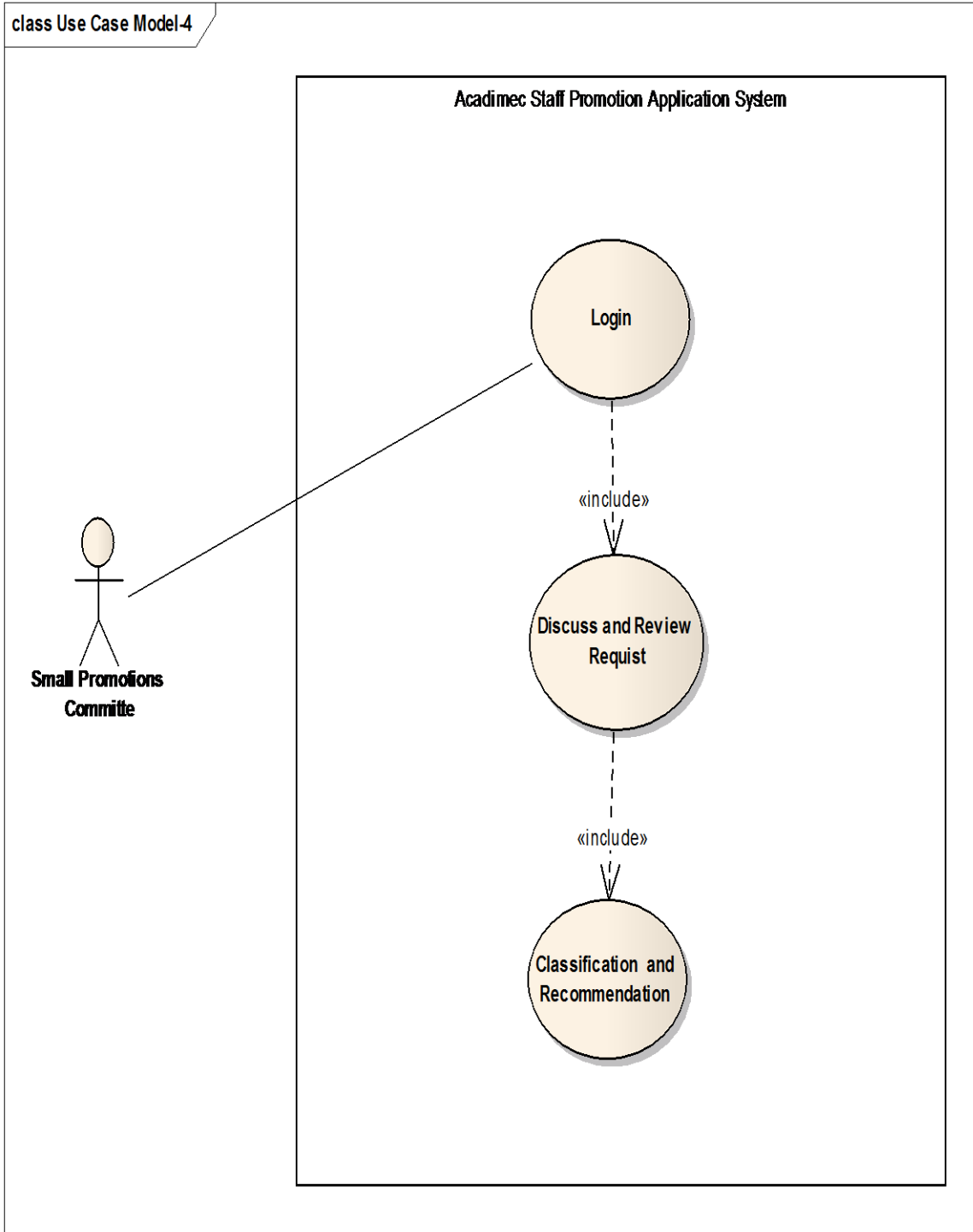


Figure [3.5] Small Promotions Committee Use Case Diagram

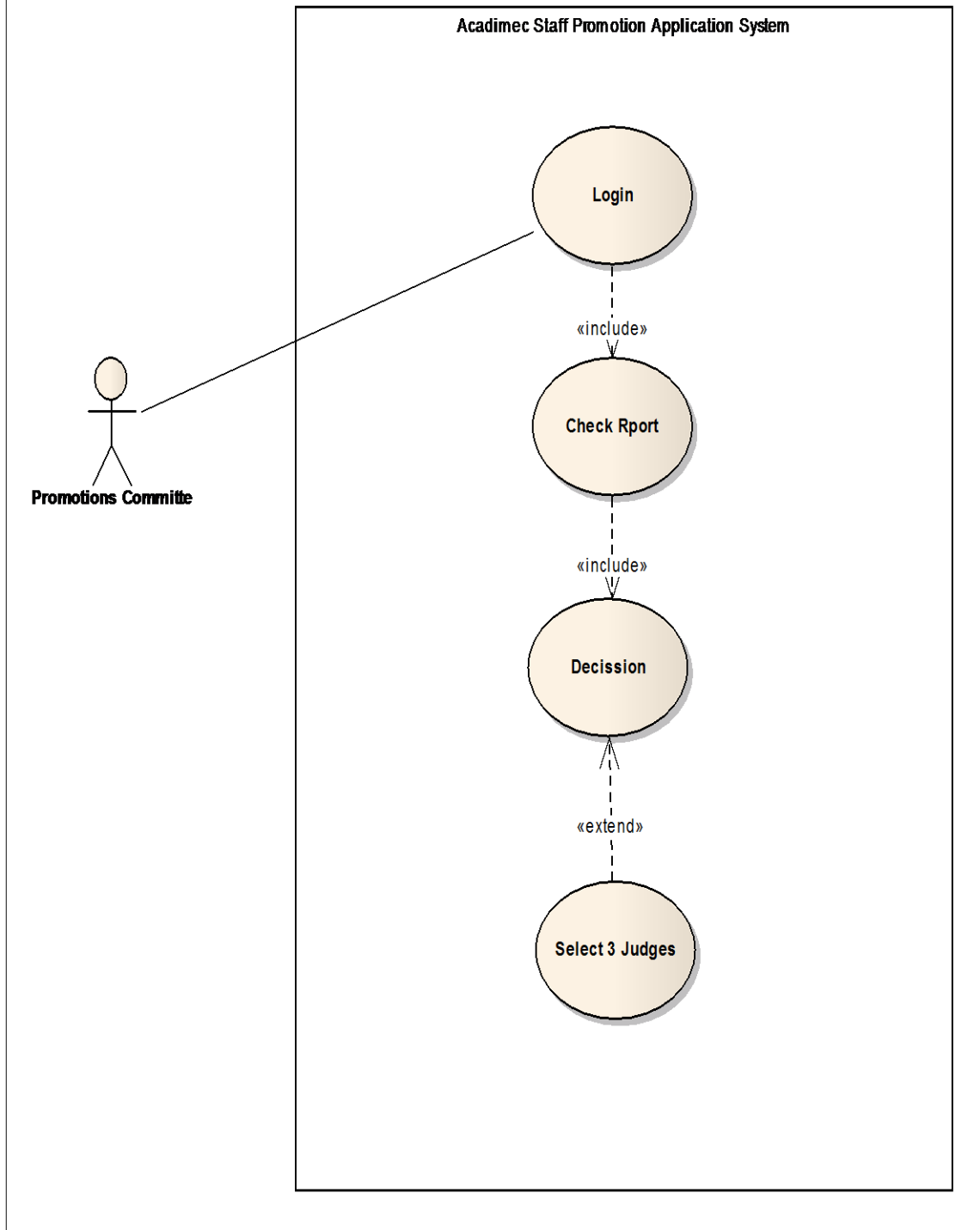


Figure [3.6] Vice Chancellor Use Case Diagram

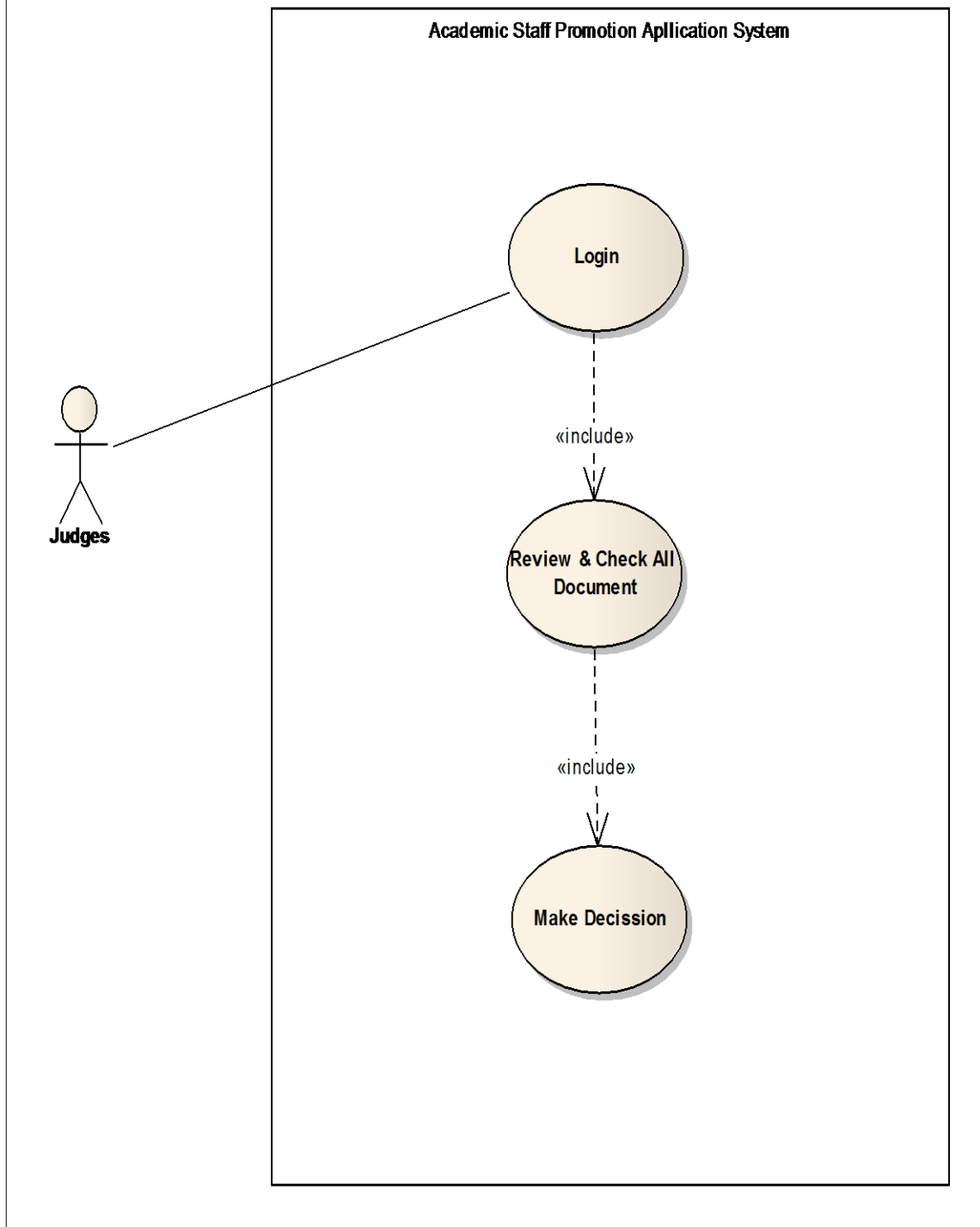


Figure [3.7] Judges Use Case Diagram

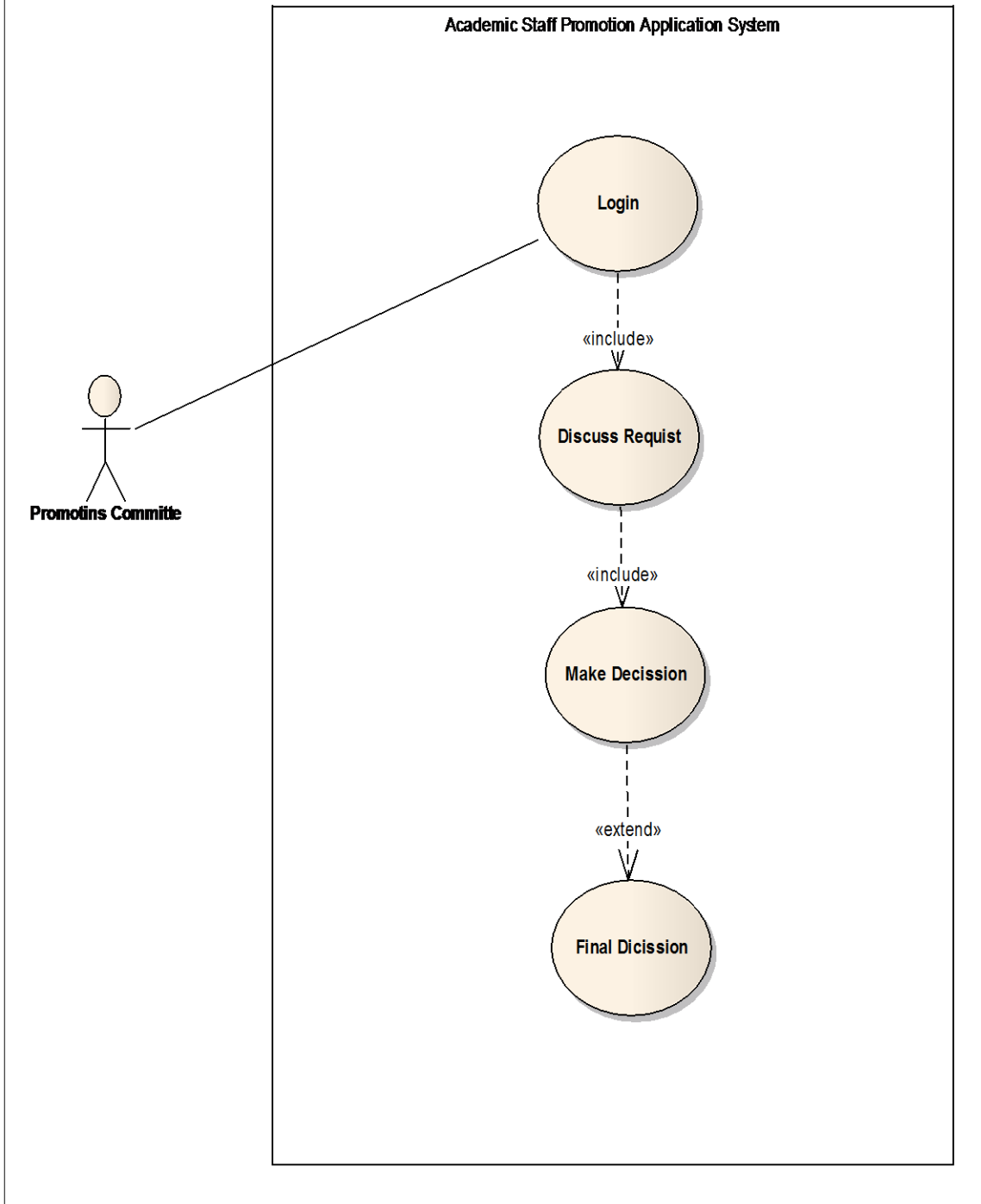


Figure [3.8] Promotions Committee Use Case Diagram

3.5.3 Sequence Diagram

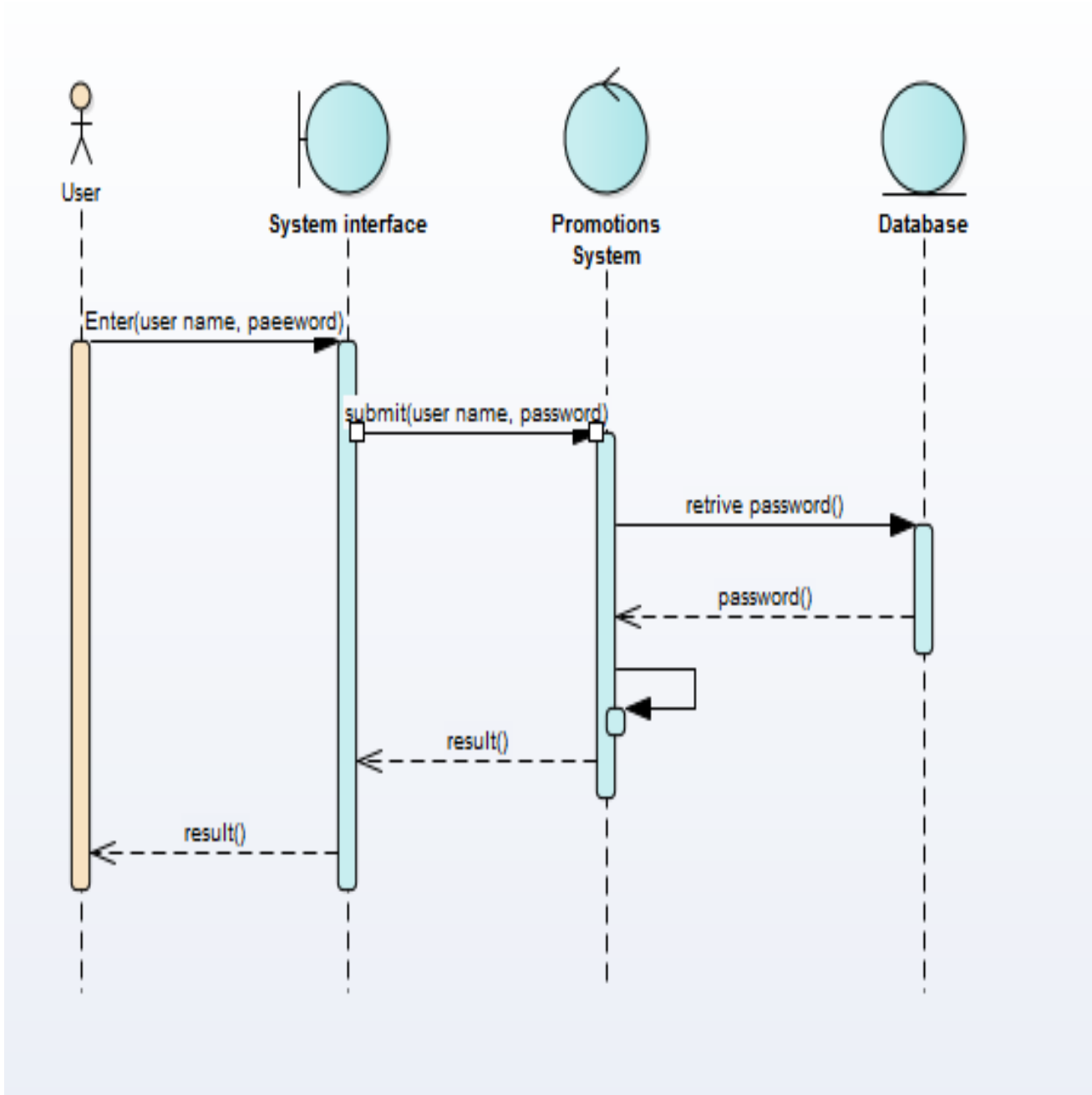


Figure [3.9] Login Sequence Diagram

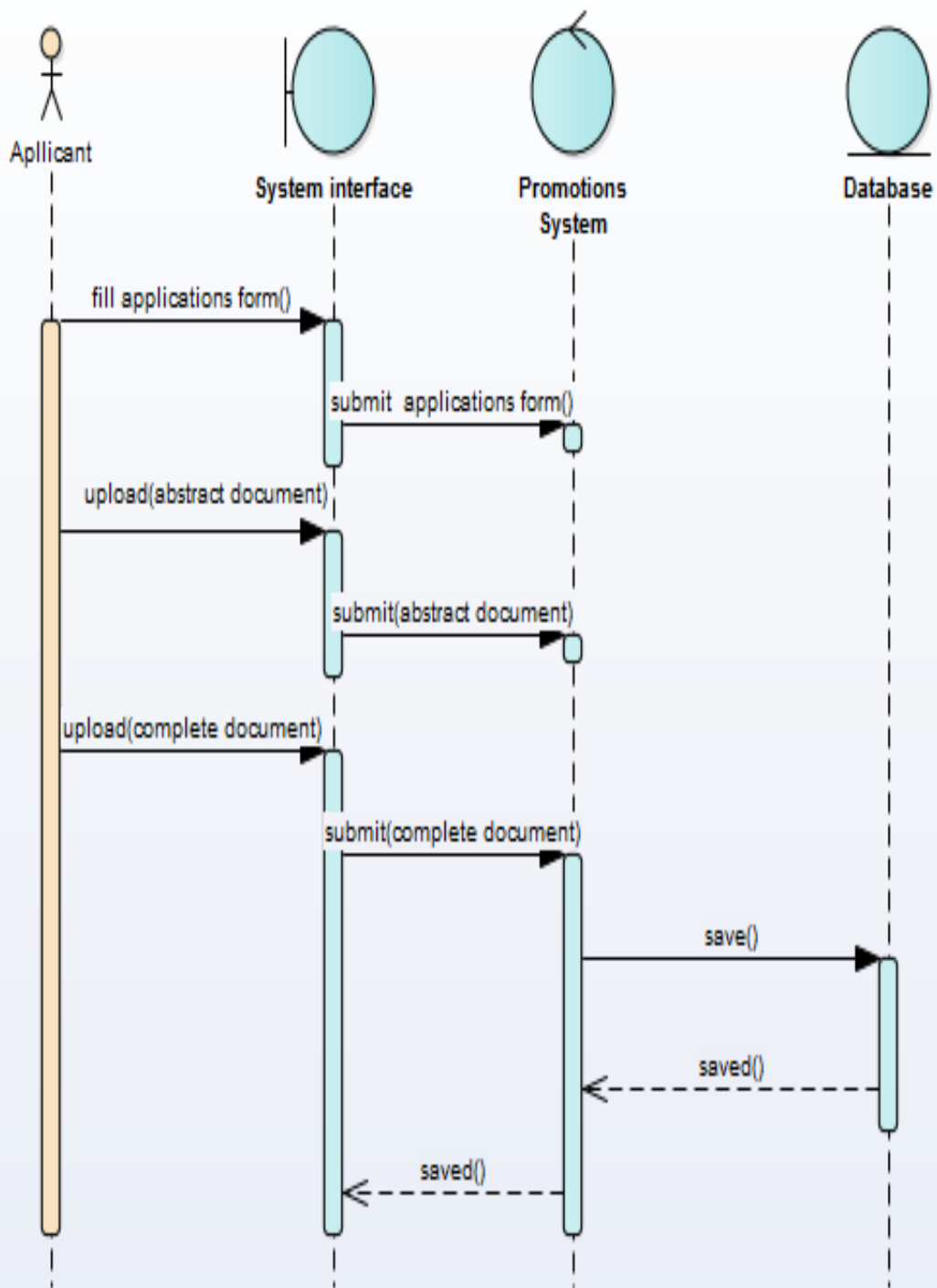


Figure [3.10] Login Sequence Diagram

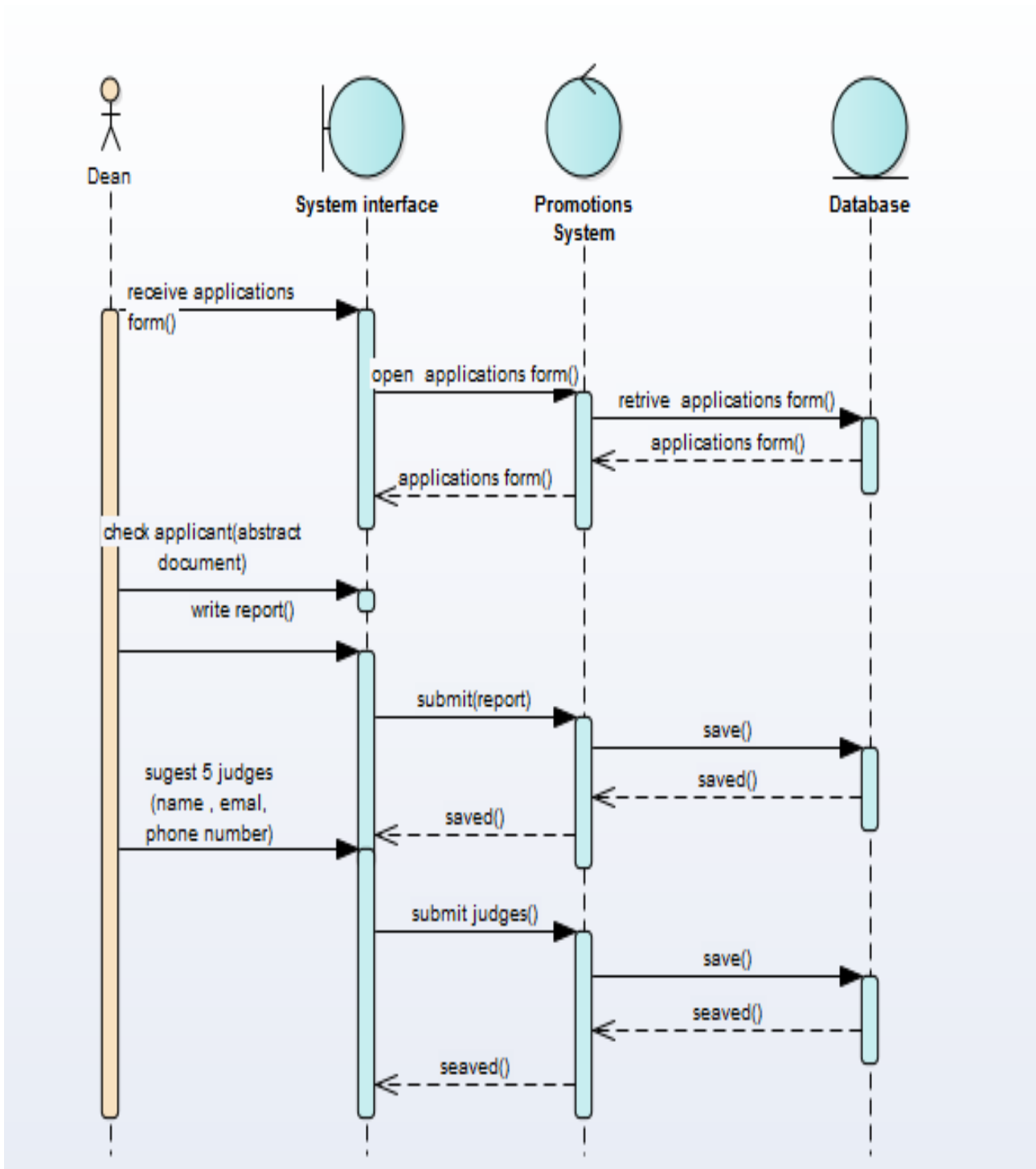


Figure [3.11] Dean Sequence Diagram

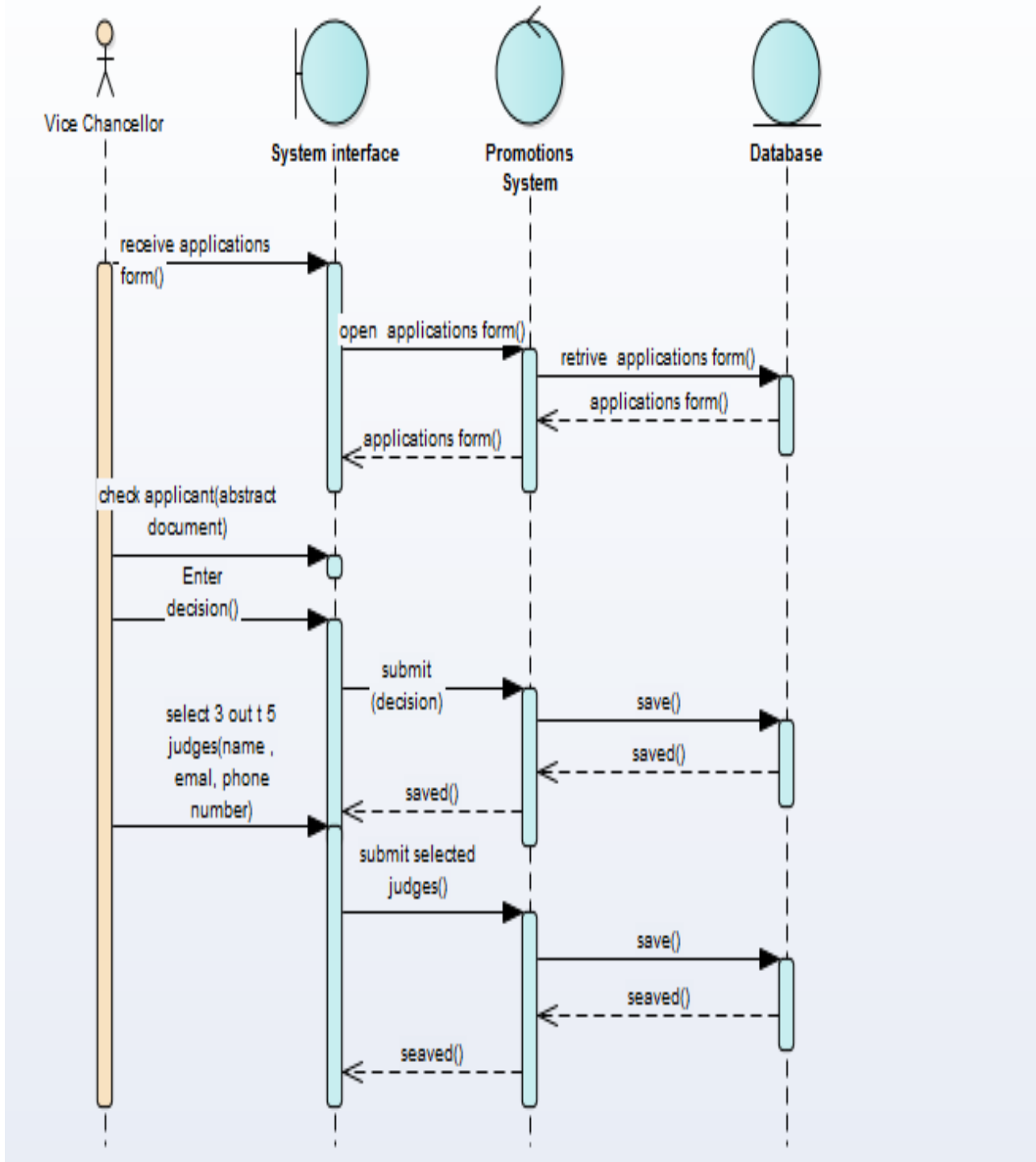


Figure [3.12] Vice Chancellor Sequence Diagram

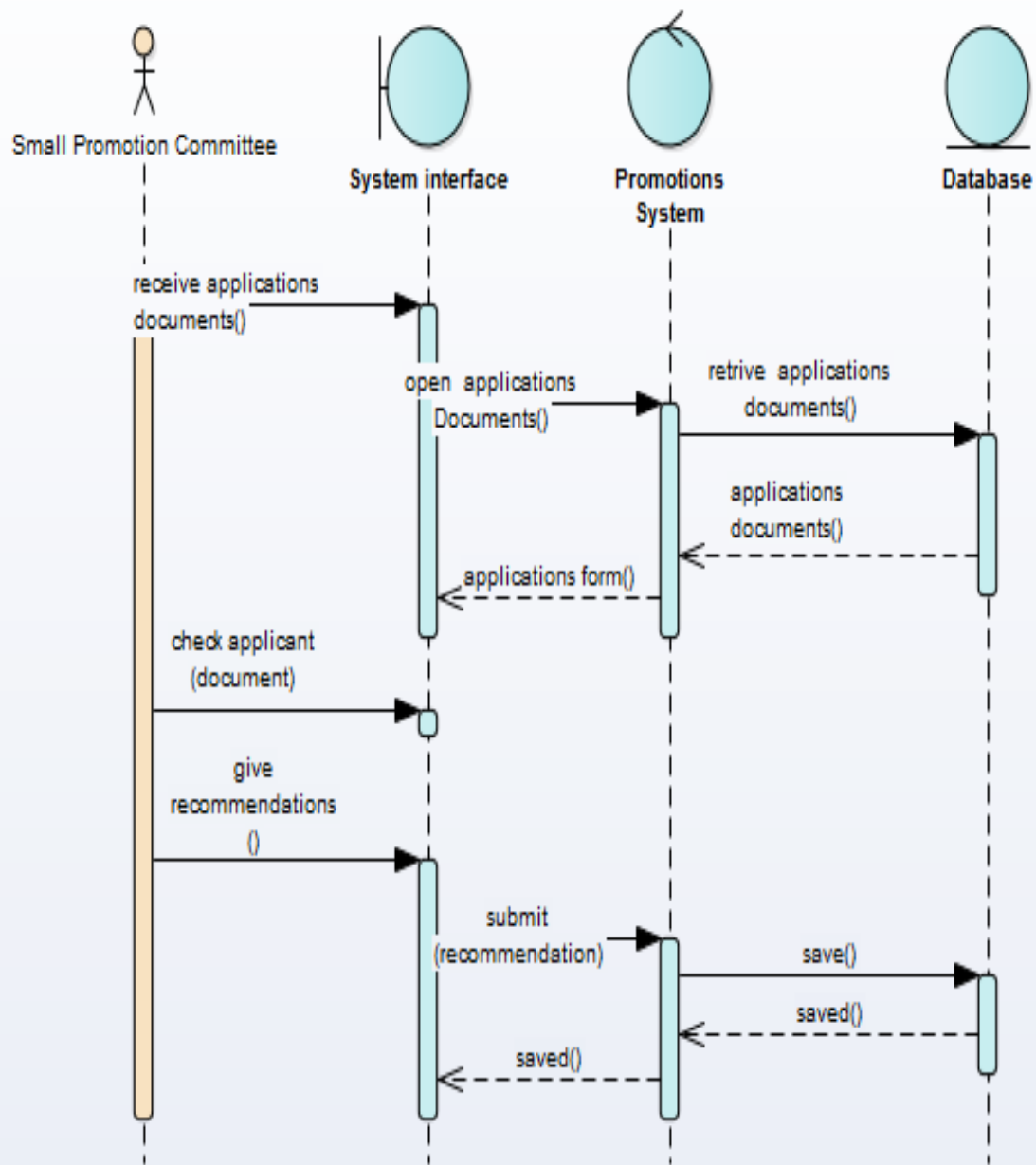


Figure [3.13] Small Promotion Committee Sequence Diagram

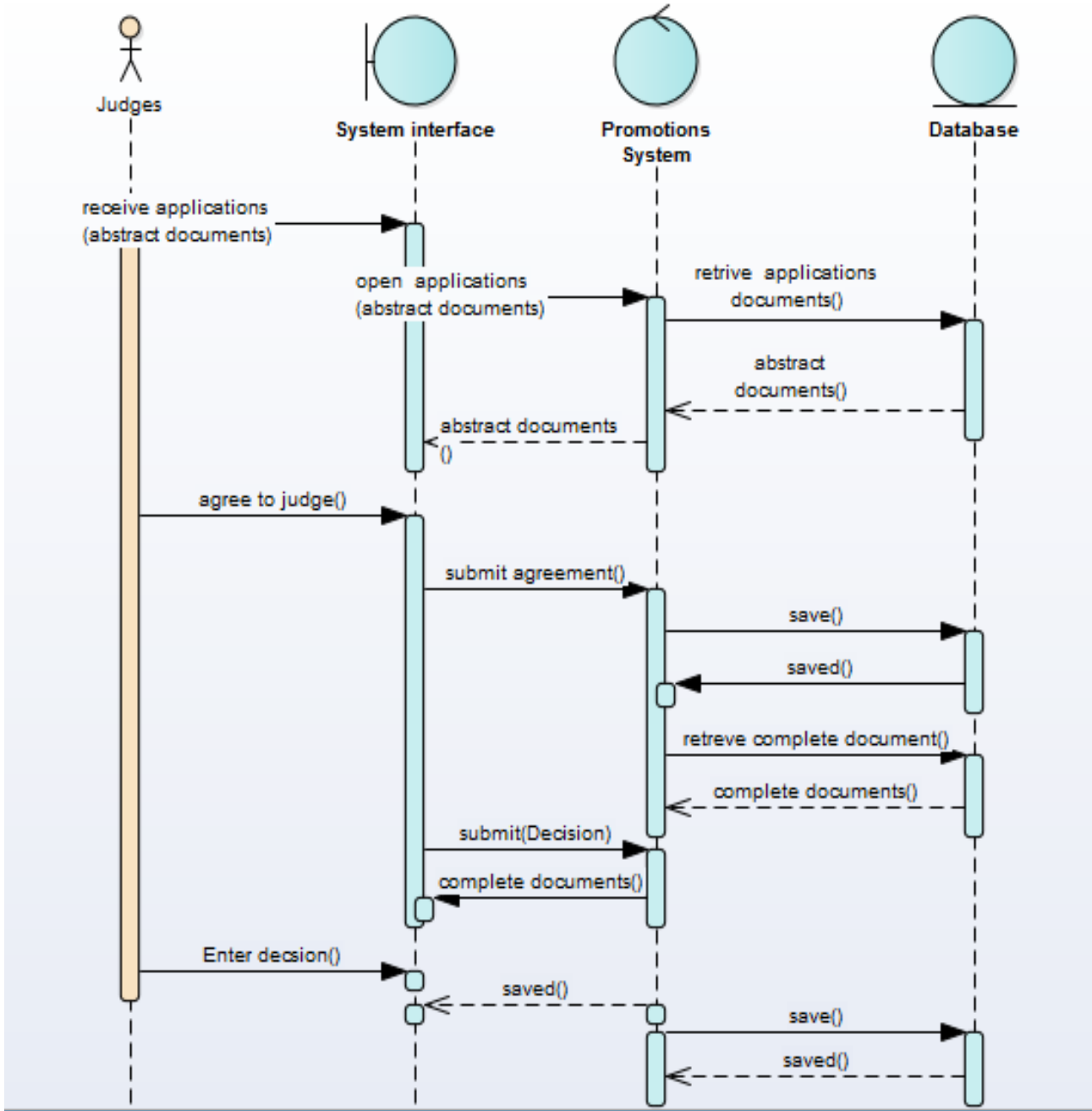


Figure [3.14] Judges Sequence Diagram

3.5.4 BPM Diagram

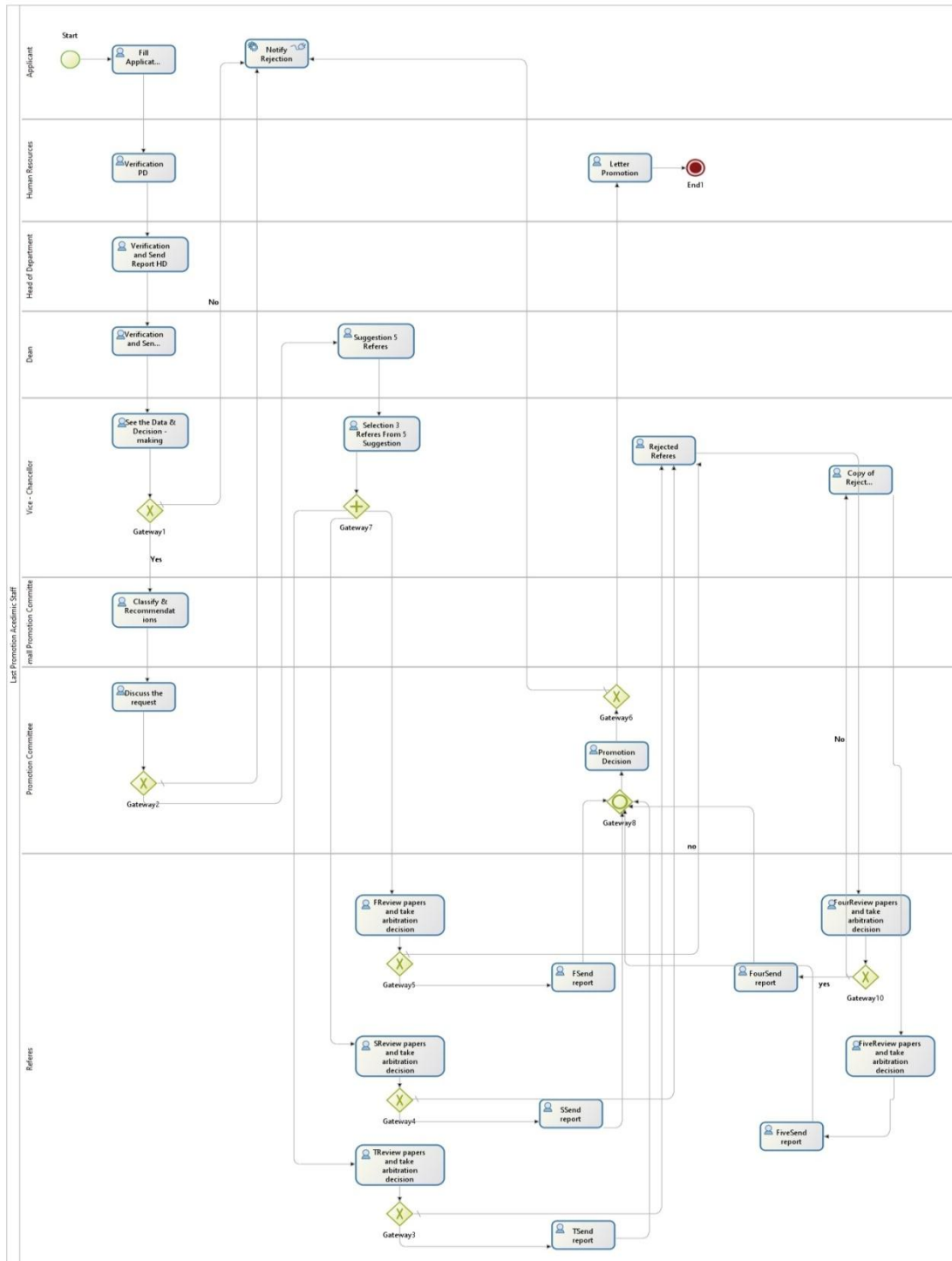


Figure [3.15] Academic Staff Promotion Application System Process in Bonita

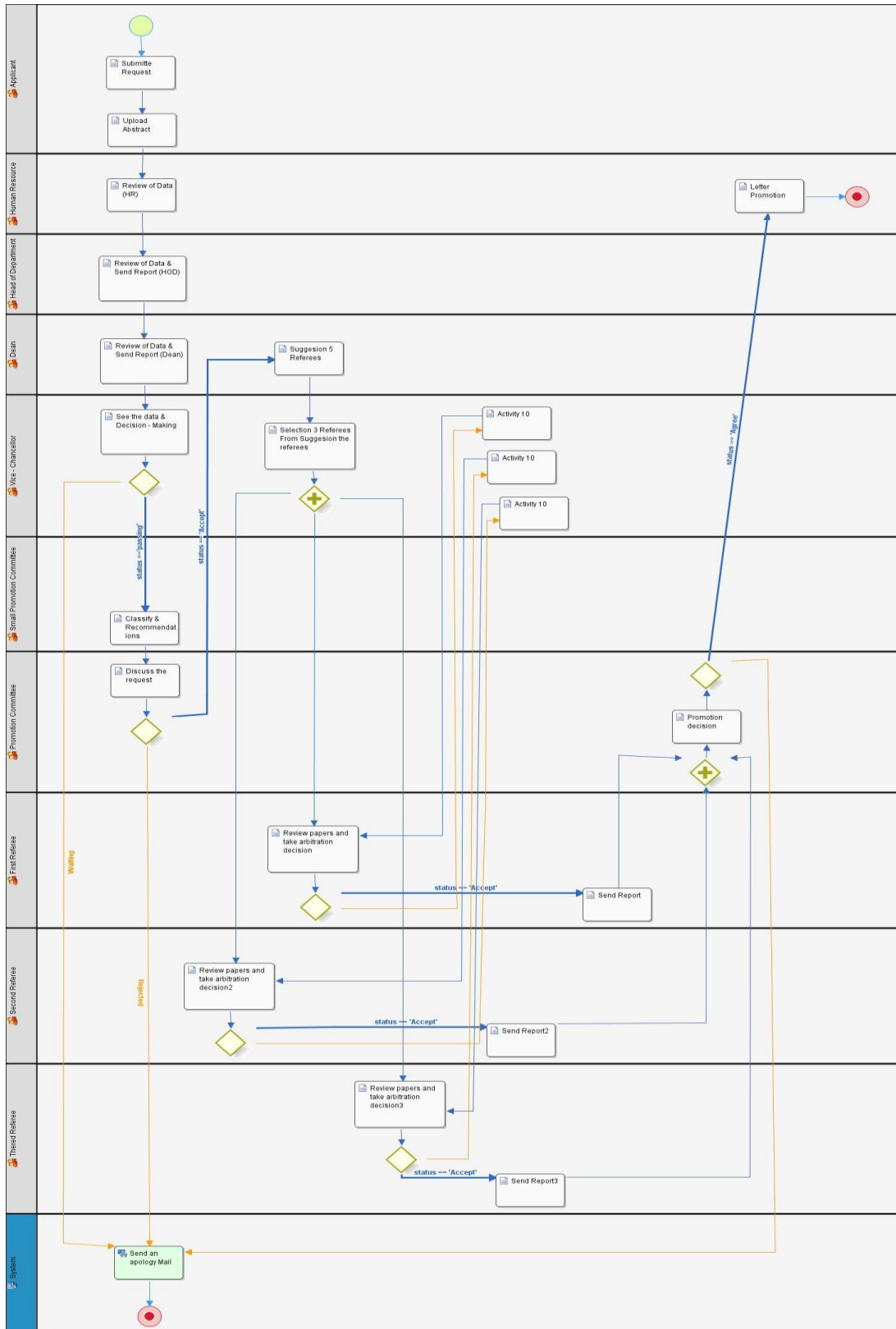


Figure [3.16]Academic Staff Promotion Application System Process in Joget

3.6 Comparison Result

	Criteria	Bonita	Joget
capability criteria	Availability of an analysis tool	Yes	No
	Tool modeling features	Yes	Yes
	Vendor support	Yes	No
	Graphical editor	Yes	Yes
	Simulation Execution engine	Yes	No
	User manual	Yes	No
	Qualified tool	Yes	No

Table [3.2] the Comparison Framework result

Chapter Four
Conclusion and Recommendations

4. Conclusion and Future work

4.1. Conclusion

This thesis provides compared two workflow management system Bonita and joget. The research was focused on the process modeling monitoring , process engine and business activity monitoring . the research shows that the Bonita tool has satisfactory performance during development, as it was quite easy to develop the case study . the research also shows that there are some differences between these tools , these differences are summarized in :

- Both tools have simple installation .
- Joget easy to utilization.
- Bonita complex to use .
- Both tools are web-based.
- Joget available there users free both tools send email message to a predefined targeted recipients can send email from value .
- Bonita can send email from value that is enter by users in executions bout joget can not send email from id participant value that is enter by users .
- The Bonita has a number of unlimited users .
- joget has three users for free .

4.2. Future Work

- The purpose of the research is to provide a framework for comparing two tools (Joget and Bonita) according to the framework that was built by collecting a lot of information from different sources. In the future we will see that the comparison between the full versions of the tools will be achieved so that a clearer comparison.
- Develop a framework to compare more features to get a standard framework for comparison and then choose the appropriate workflow management system tool.

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Appendix

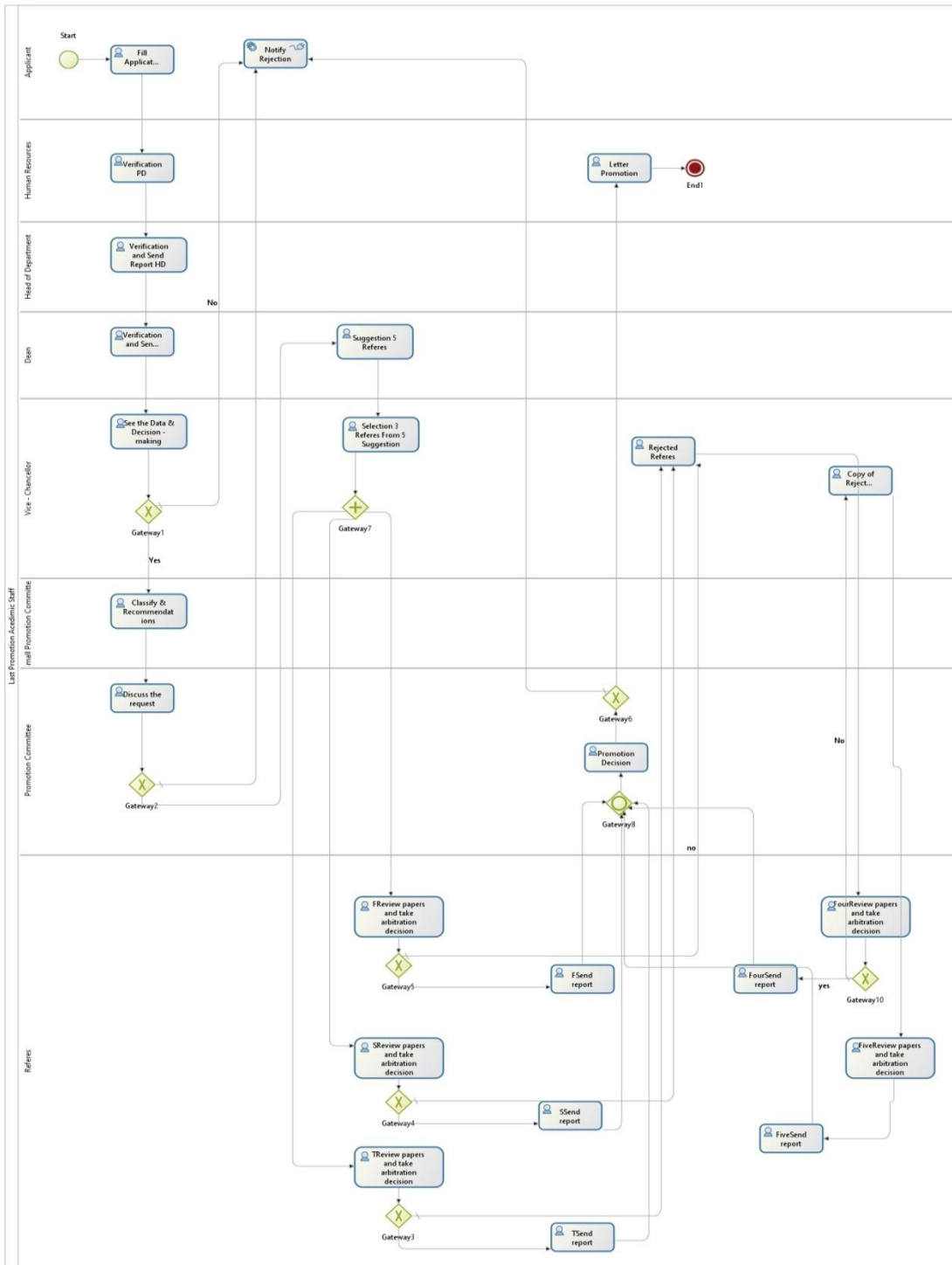


Figure [3.15] Academic Staff Promotion Application System Process in Bonita

