Group Project Report

System Analysis & Design

Introduction

The purpose of this project was to simulate implementing a new system through the systems analysis and design process. The selected project for this assignment was to implement an online self-scheduling product at Good Hope Hospital for nursing and support staff, with payroll interface. This report begins with the project's business case and scope. Then, workflow diagrams were developed to compare a functional requirement of the current scheduling system to the self-scheduling system and to further emphasize the advantages of the self-scheduling system. A user requirements matrix is also included to outline the major functional and nonfunctional requirements of the system. Use case and data flow diagrams were employed to illustrate a step-by-step process and information flow of the system. Two test cases were created to demonstrate how to detect system flaws.

Business Case and Project Scope

Mission and Vision

Good Hope Hospital is committed to providing exceptional patient-centered care by delivering compassionate and respectful care to all members of our community. Good Hope is devoted to creating and maintaining an empowering work environment to improve work-life balance of staff and to further enhance patient safety and care quality. Good Hope's vision is to be a leading hospital in the community through innovation, technology, research, and education.

Scope of the Project

Anecdotally, nurses have better work performance when they are satisfied with their work conditions which positively affects patient satisfaction. A report from the American Nurses Association states that a 25% increase in nurses' job satisfaction in a span of two years correlates with a 5-20% increase in overall quality of care delivered (Walker, 2018). The Clinical

Information Technology Department of Good Hope Hospital is diving into the challenge to initiate a self-scheduling project which aims to improve job satisfaction and ultimately improve patient care outcomes.

The self-scheduling system will allow Good Hope's 200 nursing staff and 90 support staff schedule their preferred shifts online. In addition, the program will have a payroll interface to increase efficiency and reduce errors in processing. Staff will be notified via email when shifts become available, approved, or modified. Schedulers will be notified via email when requests are submitted. The information technology team will undergo the systems development life cycle (SDLC) process and start by identifying business needs and performing feasibility analyses. Support will be sought for the project success from the key stakeholders, including nursing and support staff, nurse managers, and Good Hope Hospital Chief Executive Officer, Chief Nursing Officer, and Chief Financial Officer.

Problems of Current System

Hospitals constantly face the challenge of nursing shortage and high turnover, which not only negatively impacts workplace culture and quality of nursing care, but can also negatively impact the financial stability of the hospital. Inflexible scheduling is one explanation for high nurse turnover rate. Each percentage increase in nurse turnover accounts for additional funds ($373,200) spent on orientation and overtime charges (Wright et al., 2017). Additionally, high turnover can increase burden and stress on remaining staff. Managers who struggle with making adequate schedules for nursing staff usually feel frustrated. Furthermore, decentralized scheduling cannot optimize nursing coverage across units. Scheduling complexity, and overtime and bonus calculations can also lead to human errors in manual payroll processing.

Self-scheduling System Capabilities and Anticipated Benefits

A self-scheduling system can promote efficiency, improve satisfaction, reduce errors, and increase safety. A well designed self-scheduling system has the potential to predict patient census and nursing needs (Russell et al., 2012), thereby creating a balanced schedule, and resulting in improved nursing coverage within the hospital. The scheduling system allows nurses to access their schedules online from anywhere, anytime, and using a variety of devices. Thus, the manager's scheduling demands are substantially reduced which allows for increased time to complete other duties and responsibilities. The system also allows nurses to trade shifts to reduce absentee rates. The system will embed parameters, such as weekend and floating shifts, to meet hospital requirements and scheduling needs. In addition, the integrated payroll system will reduce errors in manual processing of paychecks. The payroll interface automates paycheck generation which is more efficient than manual processing and reduces errors on paychecks.

Through self-scheduling, nurses gain autonomy over their work schedules which creates a healthy work-life balance and the opportunity to engage in professional self-development (Wright et al., 2017). According to Koning (2014), successful self-scheduling may improve job satisfaction, morale, and professionalism for nurses, as well as create financial benefits for the organization. In turn, nurse retention due to decreased physical and psychological stress will be increased. Medical errors may be lessened as well. This is important for safety because skill mix, nurse-to-patient ratios, and experience years influence patient morbidity and mortality (O'Brien-Pallas et al., 2006). Furthermore, implementing the self-scheduling system allows the hospital to retain maximum flexibility as the demand or need for shifts fluctuates.

Risks, Constraints, and Mitigation Strategies

With any new system implementation, there may be resistance to change, especially from those who are unfamiliar with new technologies. Additionally, some users may take advantage of

the system by signing up for the more desirable shifts early, risking an imbalance between individual and unit benefits (Bailyn et al., 2007). Installing a new system also requires time and staff training which may be difficult to manage. In addition, the system is typically more expensive than paper process or spreadsheet methods. Other risks to consider with an online system include potential data breaches, malware, or cyberattacks. Additionally, hardware corruption or data malfunctions can occur, and planned and unplanned downtimes can disrupt workflow and usage of the system.

To successfully implement the self-scheduling system, involving staff in the program from the early developmental stage through implementation and evaluation is imperative. It aids in identifying needs, potential drawbacks, difficulties, and feedback of the system while providing training and education on utilizing the system. The buy-in strategy also promotes the acceptance of the system. Continuing evaluation via surveys from the management team will enable the hospital to meet the overall goal of the project.

Workflow Diagram

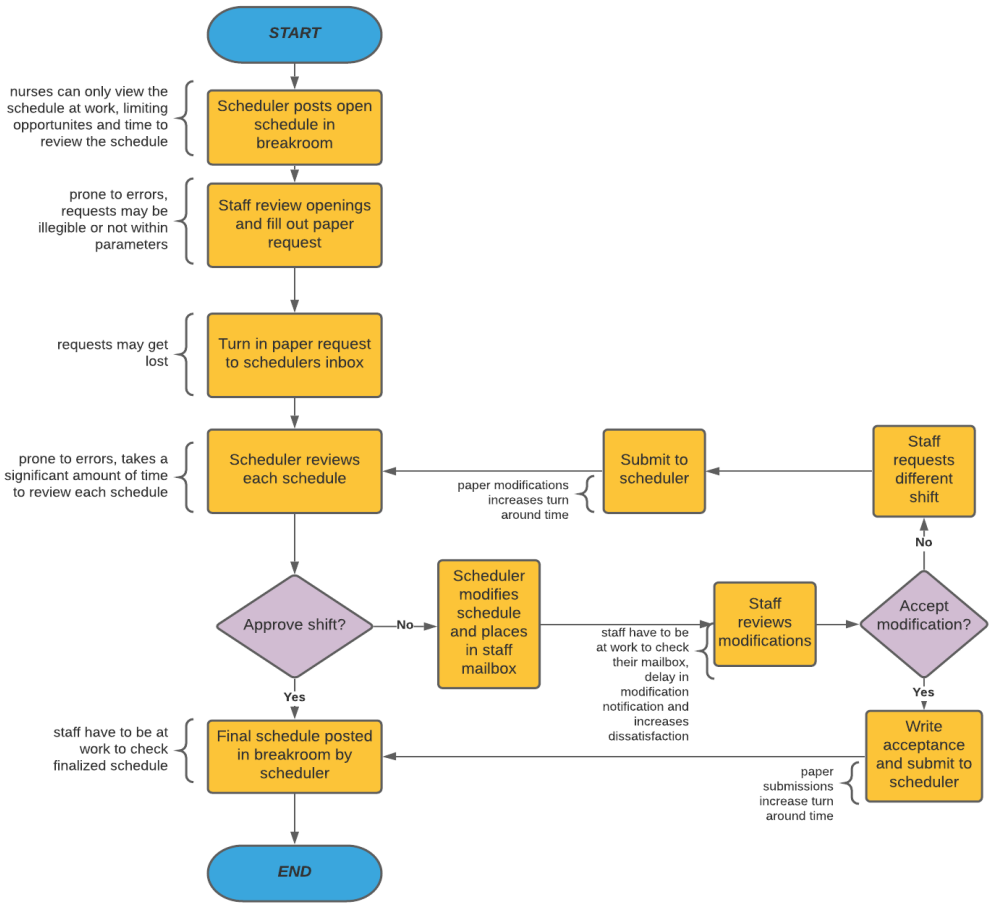
A workflow diagram provides an overview of the process and assists in identifying the critical areas. Thus, planning a workflow diagram is the initial focus of the process. In this report, the workflow diagram delineates one of the system's functional requirements that the system should allow schedulers to approve or modify shifts requested by staff online and alert users of these changes.

At Good Hope Hospital, the current state of staff scheduling involves the use of paper requests and excel spreadsheets. With this system, schedulers post the open schedule in the staff break room two months in advance. In the following two weeks, nursing and support staff will review the open shifts schedule and submit their paper requests to the scheduler's work mailbox.

Prior to modification or approval, the schedulers must manually check each request to confirm that they meet specified parameters. If the requests are modified, the scheduler notifies the staff by placing the modified request in the staff's work mailbox. This then requires the staff to check their mailbox at work to accept these modifications or place new requests. The workflow diagram of the current system is depicted in Figure 1 below.

Figure 1

Current Workflow Diagram



There are many inefficiencies, inconveniences, and areas that have increased potential for errors with the current system. Staff must come in early, stay late, or find time during their shifts to review open shifts. In some cases, staff may miss the request submission period due to

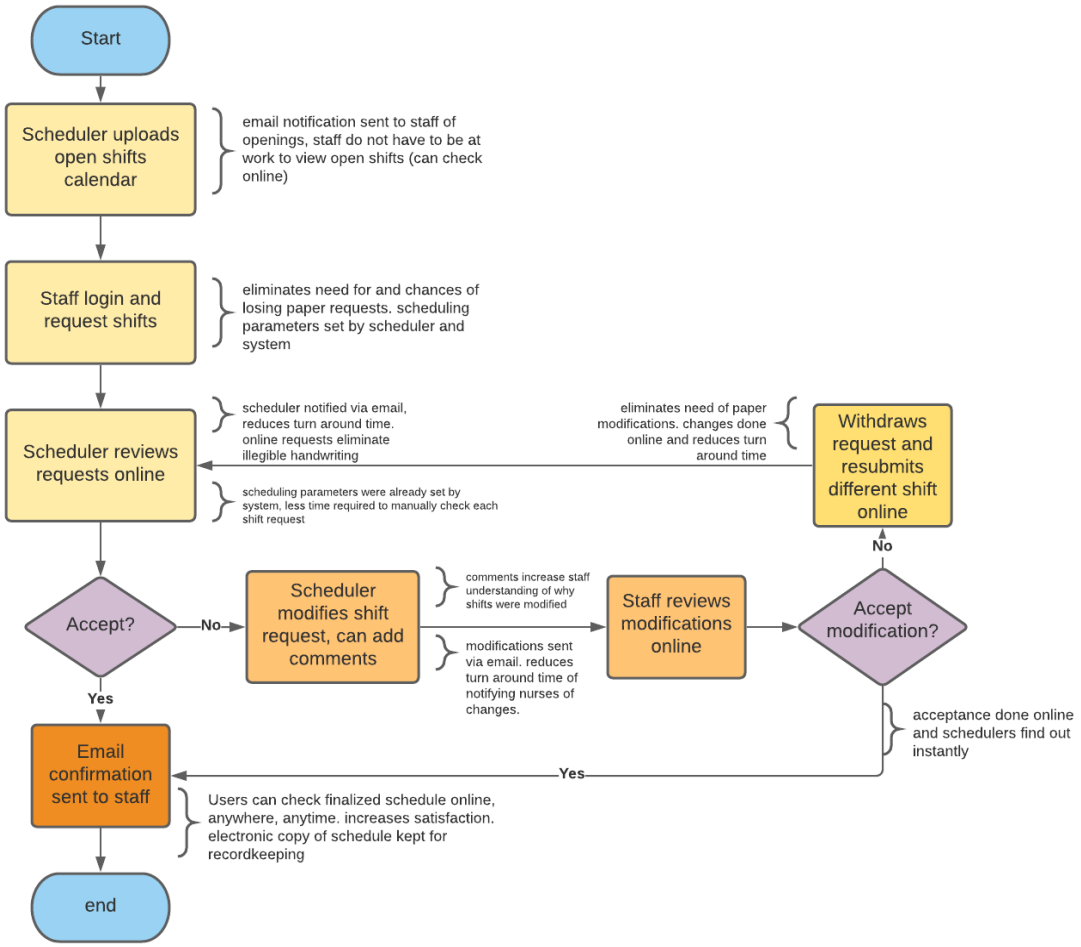
vacations or sickness which can result in late or no submissions. This in turn can create frustration for both staff and schedulers. Turnaround time is delayed because communication is done via paper mailbox notices which staff have to remember to check. Illegible handwriting and lost paper requests are also problematic and rewriting and replacing lost forms may be seen as redundant and frustrating for staff and schedulers. These issues give rise to increased turnaround time and hinder efficient communication. Subsequently, these factors bring about increased burden for schedulers, dissatisfaction among staff, and delays in releasing the finalized schedule.

A self-scheduling system, as depicted in Figure 2 below, can help improve issues in the current system. With a self-scheduling system, staff can view open schedules anywhere and anytime. Staff will receive an email notification when the open schedule is available, therefore increasing convenience and satisfaction. Scheduling will be done online which eliminates the chances of losing paper requests and misinterpretation from illegible handwriting. The system will have specified parameters in place so that the staff cannot schedule overtime or outside of their scope of practice, thereby decreasing errors. These built-in parameters decrease workload for staff and schedulers because corrections will be done less frequently. Meanwhile, the scheduler's scheduling burden is greatly reduced by avoiding manually checking each individual request for meeting parameters. Furthermore, the need to exchange shifts is tremendously decreased with self-scheduling which leads to greater efficiency and time savings for the scheduler ("Self Scheduling", 2014). When the scheduler decides to approve or modify shifts online, staff will receive an email notification, which decreases turnaround time of notifying staff. If shift modification is needed, staff can easily do so online with WiFi or cellular data. The schedulers may additionally add comments to why shifts were modified which increases the staff understanding and acceptance of the changes. When self-scheduling is completed and schedules

are approved, the scheduler will have greater confidence that all the requirements are met ("Self Scheduling", 2014). Overall, with increased efficiencies, decreased turnaround time and burden, and minimized potential for errors, a self-scheduling system increases satisfaction for both staff and schedulers.

Figure 2

Self-Scheduling WorkFlow Diagram



User Requirement Matrix and Use Case Development

Now that the fundamental workflow of the self-scheduling system is established, system requirements are to be determined, which describe what the system must do or characteristics it

needs to have (Dennis et al., 2015). It is crucial to recognize system requirements at the beginning of the project to avoid considerable costs caused by missing requirements or errors found in a later stage. A user requirement matrix (see Appendix A) was utilized to map out the major user requirements which aid in ensuring all requirements are validated.

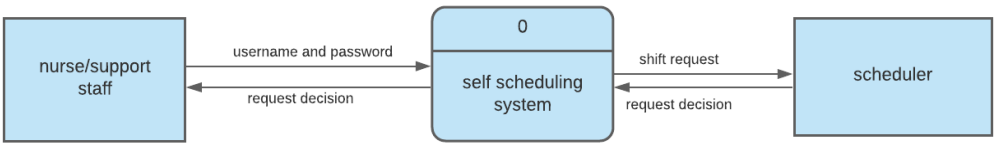
Though identifying all the requirements are ideal, it is hard to achieve, and unambiguous requirements are often missed. Use cases can potentially alleviate this issue by providing a structured requirement discussion between the developers and the users from the user's perspective. The use case of submitting shift requests (see Appendix B) is included in this report to show a step-by-step progress of how the system responds to the user's request.

Data Flow Diagram

Data flow diagram (DFD) graphically illustrates information movements of the system. It typically begins with an overview picture depicted through a context diagram. With a self-scheduling system, nursing and support staff can request shifts by logging into the system and requesting particular shifts. The scheduler then reviews the requests and nursing and support staff are notified of these decisions. See Figure 3 below.

Figure 3

Scheduling System Context Diagram

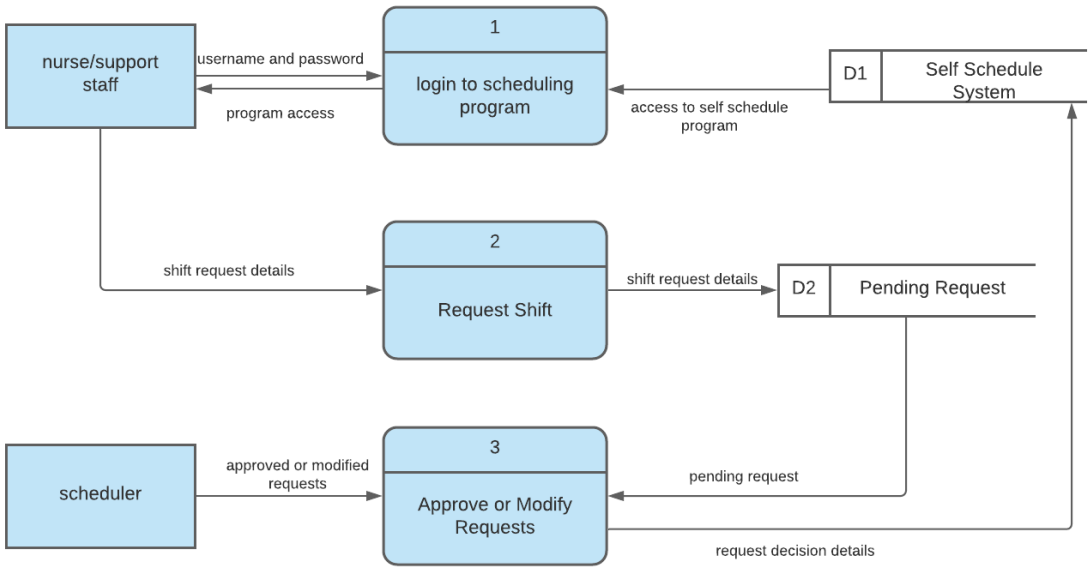


Based on the context diagram, details will be defined in the subprocesses. In this report, Level 0 and Level 1 diagrams are presented. Level 0 DFD demonstrates more details as shown in Figure 4. First, nursing and support staff enter their login information to gain access to the self-

scheduling system. Upon system approval, staff will then submit their requests by entering shift request details into the system. These pending shift requests will be sent to the scheduler who will then approve or modify the requests. After request decisions have been made, the self-scheduling system will be updated.

Figure 4

Scheduling System Level 0 Data Flow Diagram

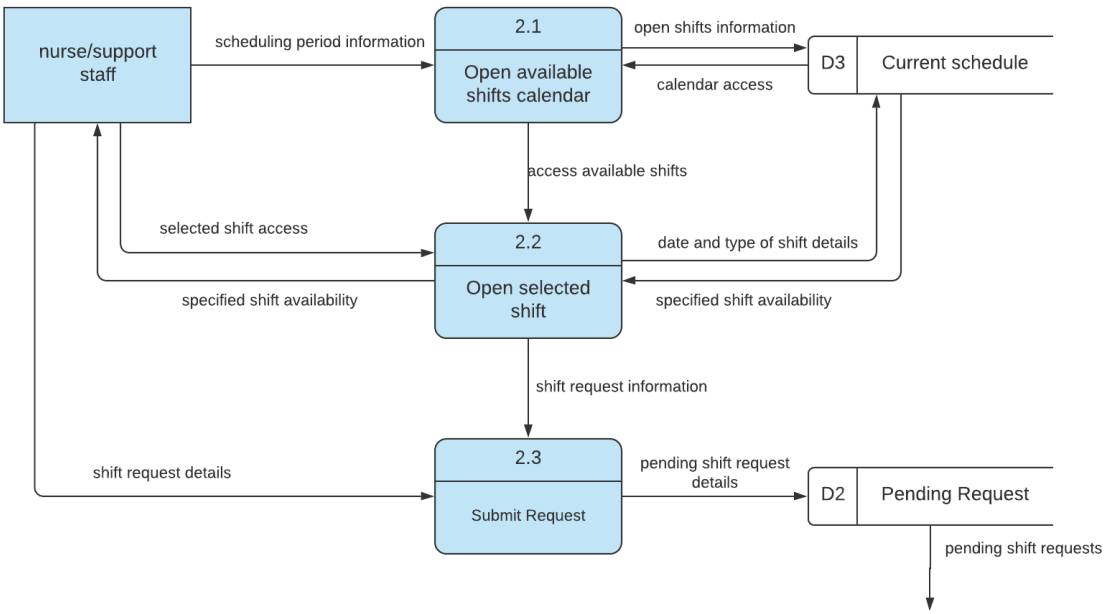


Each process depicted in the Level 0 DFD may have a corresponding Level 1 DFD. However, this report will only include one Level 1 DFD for process 2, “Request Shift” (see Figure 5). To submit shift requests, nursing and support staff must first access the open shifts calendar for the scheduling period, and then find their desired shifts based on availability. Upon finding a desired available shift, staff will select that shift, input shift request details, and submit their request. The system will alert the user if selected shifts do not meet the scheduling requirements. After successfully submitting selected requests, these pending requests will be stored in a pending requests database. The scheduler external entity has no interaction in this

process and thus is not depicted in this Level 1 DFD. The scheduler external entity would be depicted in a separate Level 1 DFD examining process 3, “Approve or Modify Shift,” which would occur after the pending request details leave the pending request database.

Figure 5

Scheduling System Process 2 (Request Shift) Level 1 Data Flow Diagram



Test Cases

Testing with the intention of detecting flaws is imperative for a system development. A flaw that remains undetected until a later stage could potentially cause tremendous costs. Therefore, system analysts employ test cases throughout every stage of the system development to ensure the system performs as desired and expected results are achieved. Two test cases, depicted in Table 1 and Table 2, are included in this report.

Table 1

Test Case #1

Test Case ID: TC001
Test Case Summary: To verify that the system will allow full-time nursing and support staff to only schedule 36-40hrs per week
Related Requirement: Functional Requirement 3
Test Procedures: 1. Select open shifts calendar 2. Select desired shifts (quantity of hours) for the week 3. Click submit request
Test Data: 1. Username and password 2. Quantity of hours per week: 35, 36, 37, 38, 39, 40, & 41 hours
Expected Result: 1. A "successful" message will be displayed if the quantity of hours is valid (36, 37, 38, 39, & 40hrs), and the request will be submitted. 2. An "invalid-hours not met" message error will be displayed if the quantity of hours is invalid (35, 41hrs) and request will not be submitted
Actual Result: 1. If the specified quantity of hours is valid, the result was as expected 2. If the specified quantity of hours is invalid, the "invalid" message error was *not* displayed and request was submitted
Status: Failed
Remarks: This test case only tests full time shift employees
Created by: Group 3
Test Environment: Windows Operating System, Internet Explorer browser

Table 2

Test case #2

Test Case ID: TC002
Test Case Summary: To verify that the scheduler receives email notifications when shift requests have been submitted by nursing and support staff

Related Requirement: Functional Requirement 4
Test Procedures: 1. Nursing and support staff submit shift requests 2. The scheduler logs into work email 3. The scheduler checks for email notification from the scheduling system
Test Data: 1. Shift requests from nursing and support staff 2. The scheduler's username and password to log into the email system 3. Nursing and support staff's username and password to log into the self-scheduling system
Expected Result: The scheduler will receive an email notification of the shift requests
Actual Result: The scheduler did receive an email notification of shift requests
Status: Pass
Remarks: This test case only tests auto email notifications sent from the system to the scheduler. The email notification of approval and modification will be covered in a separate test case.
Created by: Group 3
Test Environment: Windows Operating System, Internet Explorer browser

Summary and Implications

The current scheduling system depends on a manual process which impacts nurses' productivity, induces unavoidable errors, and proliferates financial losses in organizations. Thus, Good Hope is obligated to introduce a new system. This project aimed to improve nurse work performance and increase job satisfaction by implementing an online self-scheduling system. By applying a self-scheduling system, nursing and support staff gain more control and flexibility of their schedules which enhances efficiency, satisfaction, safety, and reduces errors. The implementation of the self-scheduling system required a complex process of data collection and interpretation, and problem identification and analysis of underlying roadblocks, to achieve a successful solution.

By learning the major requirements and challenges of a systems improvement project, team members were able to further develop communication, time management, and collaboration skills. Throughout each project component, team members were able to experience what it is like to work within a systems analysis and design team.

References

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Appendix A

User Requirements Matrix

		High	Medium	Low
Functional Requirements				
1	The system will enable nurses and support staff to view open shifts online	✓		
2	The system will enable nurses and support staff to submit shift requests online	✓		
3	The system will only allow nursing and support staff to schedule within designated parameters (ie: 36-40hrs/week for full time staff)	✓		
4	The system will alert the scheduler via email when shift requests have been submitted		✓	
5	The system will enable the scheduler to accept or modify shift requests online	✓		
6	The system will alert nurses and support staff when schedulers accepted or modified their shift requests		✓	
7	The system will allow nurses and support staff to swap online	✓		
8	The system will document working records and leaves records and retain the records for 5 years	✓		
9	The system will allow nurses and support staff to track their vacation leaves, sick/call-in leaves, attendance, and overtime		✓	
10	The system will seamlessly sync timesheet to payroll and generate pay stubs automatically	✓		
Technical and Nonfunctional Requirements				
1	The system will be accessible on computers,	✓		

	tablets, and mobile devices through Wifi or cellular data			
2	The system will be compatible with different operating systems and different web browsers	✓		
3	The system will allow for simultaneous users	✓		
4	The system will provide real-time features	✓		
5	The system will be able to integrate with the HR department to simultaneously update staff qualification status	✓		
6	The system will require password-based authentication and change of passwords annually	✓		
7	The system will load screens/pages within 2 seconds 99% of the time		✓	
8	The system supports multiple languages, including English, Spanish, French, etc.			✓
9	The system will support read-only function during downtime		✓	
10	The system will provide a failure contingency plan that back up data to a remote server every night for recovery purposes	✓		

Appendix B

Use Case Development

Use Case Name: Submit Shift Request	**ID**: UC-1	**Priority**: *High*
Actor: Primary: Nursing staff, support staff Secondary: Scheduler, Self scheduling system database/software, workstation computer, mobile devices, human resources (HR) database		
Description: This use case is to describe the situation where nursing and support staff will submit their shift requests online via the self-scheduling system. The outcome will be real time updates and notifications will be sent to the scheduler as requests are submitted, thereby decreasing turnaround time for review and schedule finalization.		
Trigger: What triggers this task? What tells you to perform this task? Nursing and support staff receive notification from the system that the open-shift calendar for the next scheduling period is available. Type: External ☒ Internal ☐		
Preconditions: Scheduling system containing built-in scheduling parameters is available and online. Nurses and support staff are authenticated users of an online self-scheduling system. Nursing and support staff have access to computers, tablets, or mobile devices via WIFI or cellular data to access scheduling systems. Communication capabilities are available through system emails.		

Normal Course:	**Information for Steps**
1. Nursing and support staff log into the self-scheduling system	Username and password (I)
2. The system displays open-shift calendar	Open-shift calendar displayed (O)
3. Nursing and support staff access selected shifts	Selected shift details (I)
4. Nursing and support staff enter selected shift details	
5. The system checks if the selected shifts meet scheduling parameters	Parameter verification (O)
6. If the selected shift violates the scheduling parameters, a. The system displays unmet requirements on the screen b. The system prompts nursing and support staff to revise selected shifts c. Repeat step 3-5 until scheduling parameters are met	Pending request (O)
7. If the selected shift meets the scheduling parameters, a. The system will prompt the nursing and support staff to submit selected shift request. b. Submitted shifts is stored in pending request database as pending requests	
8. An email notification is sent to the scheduler that shift requests have been submitted.	Email notification (O)
	key: (I) input (O) output
Alternative Course: Nursing and support staff obtain permissions from nurse manager to override certain scheduling parameters (branch from step 6a) 1. The system generate a popup window for those unmet requirements that nursing and support staff have privilege to override 2. The system prompts nursing and support staff to confirm overriding by clicking on “Yes” or “No” a. If nursing and support staff confirms overriding by clicking on “Yes”, the system will proceed to the next step	

b. If nursing and support staff click on “No”, the system will request for revision of the selected shifts c. Repeat normal step 3-5	

Post Conditions:
The system closes the process of submitting shift requests.
Submitted shift requests are stored in the pending requests database.
The schedulers are sent notifications via email of submitted pending shift requests.
The schedulers are able to approve or modify the pending shift requests.

Exceptions:

1. Account is not valid (occurs at step 1)
    1. Scheduling system login page displays username and password are not valid
    2. System allows maximum of three attempts to re-enter information or must request “forgot password” through system
2. Nursing and support staff do not have access to WIFI or cellular data to access scheduling program
    1. Unable to review open shift calendar
    2. Must wait until WIFI or cellular data becomes available
3. Staff requests schedule change outside of schedule request period
    1. staff must email scheduler to edit their request
    2. scheduler must manually edit request in the scheduling system

Summary

Inputs	**Source**	**Outputs**	**Destination**
Username and Password	Nursing and support staff	Open-shift calendar displayed	Nursing and support staff
Selected shift details	Nursing and support staff	Pending requests	Pending requests database
		Email notification	Scheduler
		Parameter Verification	Nursing and support staff