**Capstone Case Study**

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**Executive Summary**

New Century Wellness Group is a healthcare provider that services 8000 patients in the Brea, California area. Seeking to empower its employees with more powerful and efficient tools, New Century hired me to implement a new information technology system. Using primarily the structured analysis method, but with some influence from object-oriented analysis and agile methods, I worked with New Century to develop a system that would meet the company’s requirements and constraints. After conducting a preliminary investigation, I determined that a new information system would be feasible and beneficial for New Century.

Working with the users and managers of New Century, I determined the system requirements for the new system. Next, I created several diagrams to show how the different modules of the system would work and interconnect with one another. These diagrams provided a strong foundation on which to begin development of the system. With a solid understanding of the proposed system and how it should work, I recommended that New Century begin in-house development. I also created sample user interface forms to model the user interface.

Having establishing physical and logical models, I assembled a team to build the system. Working in a team with two other programmers, I wrote and tested the programs for the system. Once this process was complete, I began to train New Century’s employees, teaching them how to use the new system. The new system was implemented successfully, and New Century was pleased with the results. I continued to support the maintenance and security of the system, implementing improvements and explaining maintenance and security issues. As the support period came to an end, I ensured that New Century’s management and users would have the knowledge necessary to ensure that their information system would continue to function in the ensuing years.

**New Century Wellness Group Business Profile**

New Century Wellness Group is a healthcare provider that offers a holistic approach to health care. In addition to offering traditional health care services, New Century Wellness Group places an emphasis on preventive medicine and fitness. Though it competes with other health care providers, no other health care provider provides the same range of services as is provided by New Century Wellness Group.

Founded ten years ago in Brea, California, New Century Wellness Group has over 8,000 patients from 325 different employers. The company accepts insurance plans from 25 different licensed health insurance providers. The company is considering opening another location, and has recently decided to implement a new information system. This system will provide support for New Century Wellness Group’s business and health information management needs, with a focus on meeting both current and future needs.

New Century Wellness Group employs four primary care physicians, one nurse practitioner, four physical therapists, one registered nutritionist, eight nurses, and support staff consisting of eight members. The organization of the support staff is shown on the following page, though additional information is needed. The practice is led by Dr. Timothy Jones and Dr. Dolores Garcia, who in turn oversee the operations of the other two doctors, the remaining medical staff, and the support staff. The relationships within the remaining medical staff and the support staff is unclear; for example, it is not clear whether the nurse practitioner and the registered nutritionist are considered to be the superior of the other nurses or the registered nutritionist. Office manager Anita Davenport leads the eight-person support staff, which handles the company’s office operations such as human resources, the maintenance of medical records, accounts receivable, billing, appointments, and the ordering of supplies.

**New Century Wellness Group Organization Chart**

**Business Processes**

Several business processes are performed by the support staff. Fred Brown oversees human resources and employee benefits and is the direct superior of Corinne Summers. Their department oversees payroll, meaning that they must ensure that each employee is paid accurately and on time. This process requires a database with the pay rates of each employee, and a system that outputs information in the form of each payment. The human resources department performs similar processes regarding tax reporting and profit distribution. The former process requires data related to federal, state, and local taxes, while the latter process requires information related to the company’s profits.

Susan Gifford is responsible for the maintenance of patient medical records, which requires information from both patients and medical staff. The patients must give their contact information and other relevant details, while the medical staff can indicate prescriptions, treatments, and other medical information. Gifford generates information in the form of medical records. Lisa Sung is in charge of appointments, and thus requires the availability of medical staff and patients. She generates information in the form of appointments. Carla Herrera is responsible for ordering and organizing office supplies and medical supplies. She requires an understanding of the supplies necessary for running the practice, and generates purchasing information.

**Systems Recommendations**

Given the size of the company, I would not recommend the implementation of an enterprise computing system or an enterprise resource planning system. Such systems are expensive and are generally only implemented by large companies. Instead, I would recommend the implementation of a user productivity system to handle office work such as word processing and e-mailing. Additionally, I would recommend the establishment of a business support system and several transaction processing systems.

A transaction processing system could be useful for several processes performed by New Century. For example, Lisa Sung could use the transaction processing system to keep track of appointments, entering a new appointment into the system to ensure that medical staff are not double-booked. She could even allow patients to enter information and register for appointments online. Similarly, Tom Capaletti could allow patients to pay online. Susan Gifford could also use the transaction processing system to allow patients and medical staff to enter medical information. A business support system could be used to keep track of patients, highlighting those who have not made appointments over certain periods of time. It could also highlight particularly beneficial or profitable medical techniques that the company could then emphasize.

**Systems Development Method**

I plan to use the structured analysis method. This method is time-tested and easy to understand, even for those with little technical knowledge. Compared to agile methods, structure analysis places relatively little burden on the company’s staff, as the staff will not be expected to provide input on a series of iterations that ultimately lead to the final product. Additionally, this model will not create a series of objects, as objects would likely mean little to those who don’t have a strong understanding of computer programming. The major downside to the structured analysis method is that allows less feedback from users compared to agile methods or techniques such as JAD. However, I believe that it would be difficult for a relatively small company to spare the person-hours required by such techniques.

The structure analysis method consists of five steps: systems planning, systems analysis, systems design, systems implementation, and systems support and security. In the first phase, I will perform a preliminary investigation to understand the IT challenges of New Wellness. In the second phase, I will build a model of the new system, creating a systems requirement document that describes user and management requirements and the costs and benefits of the proposed system. In the third phase, I will create a physical model that fulfills the documents requirements for the system. I will also create a system design specification to present to users and management for approval. In the fourth phase, I will write and install the programs necessary to the functioning of the system, and will evaluate the operations and benefits of the system. In the fifth and final phase, I will maintain and enhance the system to ensure that it continues to meet the needs of New Century.

**Medical Terminology**

An Electronic Medical Record (EMR) contains standard medical and clinical data gathered in one provider’s office. It contains information such as a patient’s treatment and medical history. An EMR differs from an Electronic Health Record (EHR) in that it is not designed for sharing among different providers. An EMR is essentially a digital version of the traditional paper chart that contains the patient’s medical history with the practice. Compared to a paper record, benefits of an EMR include the ability to monitor a patient’s data over an extended period of time. Implementation of EMRs can also help ensure that patient charts are complete and clear; for example, poor handwriting is not an issue with EMRs.

A Computerized Provider Order Entry (CPOE) refers to a system in which clinicians directly place orders electronically. It was originally designed for medication orders, but now also includes orders for tests, procedures, and consultations. A CPOE system minimizes the problem of unclear ordering instructions due to issues such as poor handwriting. It can be integrated with Electronic Medical Records to ensure that the patient’s information is complete.

CPOE systems are usually accompanied by a Clinical Decision Support System (CDSS), which is designed to prevent errors at the ordering stage. A CDSS suggests standard values for drug dosage and frequency. It may also offer additional features, such as a check for drug allergies and interactions with other drugs that the patient is taking. Though the implementation of an EMR system, a CPOE system, and a CDSS offers similar benefits with regards to ensuring the accuracy and accessibility of a patient’s medical record, each system offers similar drawbacks in that they require time, money, and training to implement.

**Preliminary Investigation**

A preliminary investigation begins with the system analyst conducting meetings with key managers, users, and stakeholders to inform them of the proposed information system. In these meetings, I will describe the project and explains the roles of each individual. Additionally, I will invite comment on the project and carefully gauge employee reaction to the proposed system. These meetings will help in understanding the current challenges facing New Century, as well as what features should be included in the proposed information technology system. Ultimately, the goal of the first step of the preliminary investigation is to understand the opportunity facing New Century as it transitions to a new information technology system. Fortunately, Dr. Jones has already given me a strong idea of what the system should include. However, meeting with each individual of the support staff will give me a greater idea of what the project should include, since Dr. Jones has requested that the system enhance the capabilities of each individuals support team member.

After understanding the opportunity, the next step is to define the project scope and constraints. It is important to understand the requirements of the project, and I will create lists of what the project “must do,” “should do,” “could do,” and “won’t do.” These lists will be important for avoiding project creep, the gradual expansion of the project into areas that were not originally authorized. Accurately defining the scope is important for ensuring that the needs and desires of the client are met and that the system does not include unnecessary features that add to the time and expense of implementing the system. The “must do” list will include the creation of Electronic Medical Records, a CPOE system, and a CDSS. The “should do” list will include ways to enhance the billing system, the supply system, and the payroll and HR system. The “could do” list will be updated after meeting with the support staff and will include helpful secondary functions that could be implemented relatively easily. The “won’t do” list will include functions that are unnecessary, as well as functions that are potentially helpful but prohibitively expensive or difficult to implement. Additionally, in this step I will seek to understand the features that must be implemented immediately and those that can be fully implemented at some later date.

After defining the project’s scope, I will engage in comprehensive fact-finding. I will seek to fully understand New Wellness’s organization chart to understand its organizational structure and the responsibilities of each individual. As the support staff is relatively small, I will interview each team member, with the primary objective of determining how the system could help them more effectively complete their jobs. I will develop questions regarding their major challenges in the office and where improved technology could potentially help them. I will also interview at least some members of the medical staff to better understand how they will use EMRs, the CPOE system, and the CDSS. Additionally, I will provide each member of the medical staff with a questionnaire regarding their usage of the systems. While conducting interviews, I will also observe the company’s operations to better understand how each individual operates. I will also ask New Wellness to provide documentation of their current systems and data regarding their patients, including how often each patient makes an appointment and how often different medical procedures are recommended and performed.

After the factfinding stage, I will analyze the project usability, cost, benefit, and schedule data. By analyzing the information gathered through interviews and other means, I will gain a better understanding of the project’s predicted costs, benefits, and schedule issues. During this phase, I will create time and cost estimates for the next phase of the systems development lifecycle, which is systems analysis. I will seek to ensure that the data is accurate for the feasibility study.

**Feasibility Study**

Dr. Jones’s proposed system would likely be used effectively. As Dr. Jones himself proposed the system, it has buy-in from the top level of management. Dr. Jones has not indicated an interest in workforce reduction, but by simplifying the tracking of medical records, appointments, supplies, and billing, the support staff would likely have to devote less to the work stemming from each patient. These employees could in turn handle an increased volume of patients, which could stem from the opening of a new location for New Century. Though the implementation of a new system will require a training period that could lead to some annoyances for customers, the benefits of the new system will ultimately justify this temporary disruption. The successful completion of this training period will be particularly important, as the implementation of a new computer system could make information less accessible for those who do not have a strong understanding of how to use computer systems. It is unlikely that the new system will prevent legal risks or pose a threat to the company’s goodwill. By allowing some customers to potentially access services online, New Century could improve goodwill among some patients who like having access to services online.

Over the long-term, the benefits of implementing the system will likely outweigh the system’s total cost of ownership. Costs of the system include the cost of developing and implementing the software, as well as other tangible costs such as the potential purchase of new computer systems and other equipment if the current equipment cannot handle the new software. The total cost of ownership also includes intangible costs, such as the potential adverse impact of implementing a new system for employees who are accustomed to the old system. However, these costs are outweighed by the tangible and intangible benefits associated with the product. The system can be developed in a user-friendly way that will improve job satisfaction and provides more complete information. For example, employees will never be forced to search for patient records or attempt to read illegible notes from medical staff. Most importantly, the tangible benefits of the system will include more efficient methods of tracking medical records, appointments, supplies, and billing that will reduce the amount of time each member of the support staff must spend on each patient.

Relatively little information is available regarding the system’s technical and schedule feasibility. New Century does not have an IT department and it is unclear how well the company’s support and medical staff could handle a new information system. Nor is it clear whether the company currently has the hardware necessary to implement such a system. Given the lack of an IT department and the unknown level of technological savvy among current team members, a prototype of the system will likely be required to elicit user feedback. However, Dr. Jones has provided a clear vision of how he would like the system to operate, and the system would integrate well with the company’s operations. More information is also needed regarding schedule feasibility. Management has not established a firm timetable or explained how they would like the system to be implemented.

**Preliminary Investigation Report**

Dr. Jones of New Century Wellness Group proposed that I conduct a study regarding the implementation of a new information technology system that would support the functions of New Century. Dr. Jones requested that the system enhance the scheduling, billing, payroll, and accounting functions of New Century and provide support to the clinical applications of Electronic Medical Records, Computerized Provider Order Entry, and a Clinical Decision Support System. Having conducted a preliminary investigation, I recommend that New Century Wellness Group proceed with plans to implement a new information technology system.

In a feasibility study, I found that Dr. Jones’s proposed system would be operationally and economically feasible. The system would support the strategic goals of New Century, which potentially include opening a new location. The new system would also reduce the employee hours that must be devoted to each patient, ensure the accuracy of records, and potentially allow patients to access their information on-line. Though implementation of the system will present challenges, the benefits of the new system will ultimately outweigh the total cost of ownership. However, more information is needed with regard to the technical and schedule feasibility of the system. More information is needed on exactly how the system will be implemented and which members of New Century will participate in the creation of the system. However, based on the information currently available, I believe that the system will increase New Century’s profitability, align with New Century’s long-term goals, and improve employee morale and customer satisfaction.

**Project Management Concepts and Benefits Powerpoint**

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*Please note that there is an embedded PowerPoint presentation on this page*

**Project Management Terms**

Scope: the project’s boundaries and extent. For example, the scope of a new appointment system might include allowing users to make appointments online.

Project creep: the expansion of the project’s scope without authorization. An example would be if the appointment system also came to include a new billing system without specific authorization.

Constraint: a requirement or condition that a system must satisfy. An example might include a human resources system that provides adequate protection of Social Security numbers.

Project manager: A systems analyst or IT department leader who handles project planning, project scheduling, project monitoring, and project reporting.

Work breakdown structure: a char that breaks the project down into a series of smaller tasks. Examples include Gantt Charts and PERT/CPM Charts.

Tasks: In the context of project management, any activity that has a beginning and an end. Project managers track tasks to ensure the timely completion of the project. An example could include distributing questionnaires.

Task patterns: A logical sequence of tasks. The three basic forms are dependent tasks, multiple successor tasks, and multiple predecessor tasks. For example, having to schedule an interview before conducting it would be an example of a dependent task pattern.

Critical path: the series of tasks that, based on time estimates, ultimately determine the project’s completion date. The critical path is found by examining task dependencies and estimated task durations. Example: Task A is estimated to take three days, Task B is estimated to take four days, and Task C is estimated to take five days. Task B and C cannot begin until the completion of Task A. The critical path would consist of Task A and Task C since the completion of Task B is irrelevant to the final date of the project, assuming that Task B is completed on schedule.

Risk management: the process of identifying, analyzing, anticipating, and monitoring risks. Any project will have a risk management plan that includes a review of internal and external factors that could affect the project.

**Organizing the JAD Team**

The JAD team will consist of myself, Dr. Jones, Anita Davenport, Fred Brown, Lisa Sung, Tom Capaletti, and Tammy Alippio. In the role of JAD project leader, I will lead JAD sessions, explain JAD methods, and develop the session agendas. Dr. Jones’s presence on the team will ensure organizational buy-in from the top level of the organization. Jones also has the best understanding of future needs and could provide insight into how the business support system could integrate with a medical practice support system. Davenport will provide an understanding of how the proposed system should work within her department. The other four members represent the key users; Fred Brown oversees human resources and (through Corinne Summers) payroll, Lisa Sung handles patient scheduling, Tom Capaletti is responsible for accounts receivable, and Tammy Alippio is the insurance billing specialist. These users will provide valuable feedback on several topics, providing a vision of how their operations currently work and how the system can benefit those operations. Their participation will ensure that they can successfully navigate the user interface and use the new system.

I will strive to truly listen to the concerns of users and managers, both for the practical reason of gathering information but also in order to make them feel appreciated as valuable contributors. I will stress that they are vital parts of a JAD team that is intent on creating a system that will make a noticeable difference in the ease and efficiency of their day-to-day activities. By stressing each team member’s importance and the benefits of the project, I believe that I can keep morale high on the JAD team.

**System Requirements Checklist**

**Outputs**

* Provides a reminder list of patients who are past due for an appointment another list of patients whose payments are overdue.
* Creates an online calendar for the availability of medical staff.
* Creates a daily appointment list.
* Outputs a patient’s billing history and medical insurance provider(s) upon request of office staff.
* Generates a human resources report that indicates payroll and benefit information for the employees of New Century.
* Outputs a patient’s medical history.

**Inputs**

* The office staff enters appointment data, which include the patient name, the assigned medical staff, and the date.
* The office staff enter billing information, including patient name and insurance provider.
* Medical history can be entered via tablet.

**Process**

* The appointments system checks the availability of medical stuff to ensure against double-booking.
* The appointments system checks the billing status of patients to ensure those with overdue balances are not scheduled.
* The human resources report updates employee information and tax data at the end of the year.

**Performance**

* The system must support 20 users simultaneously.
* The system must be operational during business hours.
* The calendar must be updated within one minute of receiving input.

**Control**

* Only medical staff and authorized support staff can access a patient’s medical history.
* The system creates an error log that properly indicates errors.
* The system requires all users to log-in.

**New Century Patient Questionnaire**

New Century has decided to implement a new business support system. Your input is valuable in helping us build a new information system that will benefit the patients of New Century. Please fill out the following questionnaire and submit it to the front desk. Thank you!

1. How long have you been a patient at New Century?
2. On a scale of 1-10, how would you rate your satisfaction with the current process of making appointments?  
   1 2 3 4 5 6 7 8 9 10
3. What would you like to see change about the appointment-making process, if anything?
4. On a scale of 1-10, how would you rate your satisfaction regarding New Century’s communications with your insurance provider?  
   1 2 3 4 5 6 7 8 9 10
5. Do you have any suggestions for ways that New Century could better communicate with your insurance provider?

Questionnaire Sampling Method

We will ask each patient to anonymously fill out a questionnaire at the time of their visit to ensure that they feel comfortable in voicing their opinion. We will use a stratified sample of individuals of different ages to ensure that the needs and opinions of each age group are understood.

**Context Diagram**



DFD-0



**Appointments Processing**



**Payments Processing**



**Report Processing**



**Record Processing**



**Data Stores and Data Flows**

**Data Stores**

Calendar:

Date/time of appointment

Patient name

Patient telephone number

Service to be performed

Assigned personnel

Employee Availability:

Time during which employees are available

Patient information:

Patient name

Insurance provider

Payments made

Payments due

Address

Telephone number

Services performed

Insurance company information:

Patients insured

Payments due

Payments made

Claims denied

Reasons for claims denied

Provider information:

Name

Salary

Attendance

Vacation time

Paid time off

Charges generated

Medical information:

Patient name

Services performed

Patient medical information

**Data flows**

Appointments chart:

* Medical staff provides their availability to support staff
* Support staff enters that data, which goes into employee availability data sink
* Patients provide their availability to support staff
* Support staff use patient availability and employee availability to schedule appointment on calendar
* Calendar provides data to the automated generate reminders process
* The reminders process automatically contacts patients
* The calendar provides information to the generate appointments list process
* The generate appointments list process provides an appointment list to each member of the medical staff
* The calendar provides patient information maintain records process
* The calendar provides employee information to the maintain records process

Payment and insurance processing chart:

* The patient makes payments, which are recorded in the process payments process
* The insurance company makes payments, which are recorded in the process payments process
* The process payments process sends patient information to the patient information data store
* The process payments process sends insurance company information to the insurance company information data store
* The patient information data store sends patient information data to the maintain records process
* The insurance company information data stores sends insurance company data to the maintain records process
* Updated patient information is received by the patient information data store from the maintain records process
* Updated insurance company information is received by the insurance company information data store from the maintain records process
* The patient information data store sends patient information to the generate payments owed process
* The insurance company information data store sends insurance company information to the generate payments owed process
* The generate payments owed process sends outstanding payments owed to insurance companies
* The generate payments owed process sends outstanding payments owed to patients

Report processing chart

* Medical staff provide information to the enter provider information process
* The enter provider information process provides information to the provider information data store
* The provider information data store sends employee information to the maintain records process
* The maintain records process provides update employee information
* The enter medical information process provides medical information to the maintain records process
* The enter medical information process receives updated medical information from the maintain records process
* The records maintenance process provides updated information to the generate monthly reports process
* The generate monthly reports process provides monthly employee reports to the medical staff

Records maintenance chart

* Patient information is received by the maintain patients record process from the appointments process
* Patient information is received by the maintain patients record process from the payment and insurance processing process
* Patient information is received by the maintain patients record process from the report processing process
* The maintain patients record process sends updated information to appointment processing
* The maintain patients record process sends updated information to payment and insurance processing
* The maintain patients record process sends updated information to report processing
* Insurance company information is received by the maintain insurance company records process from the payment and insurance processing process
* Insurance company information is received by the maintain insurance company records process from the report processing process
* The maintain insurance company records process sends updated information to payment and insurance processing
* The maintain insurance company records process sends updated information to report processing
* Employer information is received by the maintain employer records process from the payment and insurance processing process
* Employer information is received by the maintain employer records process from the report process
* Employer information is received by the maintain employer records process from the appointments process
* Employer information is sent by the maintain employer records process to the report processing process
* The maintain provider records process receives employee information from the appointments process
* The maintain provider records process sends employee information to the appointments process
* The maintain provider records process sends updated employee information to the report processing process

**Data Dictionary and Process Description**

**Data dictionary: Enter Availability Process**

Name: Employee name

Alias: Provider name

Type and length: Alphabetic, 30 characters

Default value: none

Acceptable values: none specified

Source: Employees

Security: Office support staff, individuals (for own record)

Responsible user(s): Office support staff

Description and comments: The employee’s name

Name: Availability

Alias: Unavailable dates

Type and length: Numeric, 10 characters (e.g. 06/06/2004)

Default value: none

Acceptable values: 10/16/2017-10/16/2019

Source: Empoyees

Security: Office support staff, individuals (for own record)

Responsible user(s): Office support staff

Description and comments: The employee can provide dates up to two years in advance in which they are not able to provide medical care

**Process description: Enter Availability Process**

Process: Enter Availability Process

Description: The process allows employees to enter dates in which they are unable to work

Process number: 1

Process description:  
Input: Availability info from medical staff  
Output: Availability info to the employee availability data store



Use Case Diagram



Class Diagram: Creating an Appointment



Sequence Diagram: Creating an Appointment



Patient State Transition Diagram



**Systems Requirements and Economic Feasibility PowerPoint**



*Please note that there is an embedded PowerPoint presentation on this page*

**PowerPoint Handout**

* **Estimated useful life**: the time period during which the proposed system will provide useful support to business functions. The system will likely require replacement at the end of this period.
* **In-house development**: the process in which a company develops its own software applications. In this case, the New Century would potentially be hiring a consultant to develop software to its specifications.
* **Net present value:** the value of the project adjusted to reflect the point in time at which costs and benefits occur.
* **Ongoing support**: vendors of vertical software packages provide ongoing support to clients to meet technical needs.
* **Return on investment**: the percentage rate that compares the project’s benefits to its costs.
* **Vertical software package:** an externally developed software suite that can be purchased from specific vendors. Though it should meet most or all company needs, it will not be customized to New Century’s specifications.

**Input Screen Control Features**

Several control features will be implemented to ensure accurate data entry. Each field has a descriptive caption to ensure that the user understands the fields into which they are entering data. The form will autogenerate patient IDs when entering a new patient into the system. Fields with dates or IDs will have an input mask to ensure that the field only consists of the correct number of digits. The system will also perform a data type check for other fields, such as names. Entry into each field will not be complete until the user presses the tab key or enter key; otherwise, the field will remain blank. When entering IDs (except for new IDs being generated), the system will perform an existence check. The system will perform a range check for appointment times to ensure that they fall within business hours. The system will also perform a reasonableness check on appointment durations to check for inaccurate data entry.

**Alternative Output Technologies**

New Century may make use of several output technologies aside from printed reports. The user interface should be optimized to allow for information to be transferred via email. Additionally, the system could be connected to the internet in such a way that patients could view their own records online. Finally, data within the system should be able to be transferred to bulk storage devices such as magnetic tape or microfilm.

**Entity-Relationship Diagram**



**New Century Network Model**



**Network Model Recommendations**

Based on the requirements of New Century Wellness Group, I recommend a star network. As shown in the diagram on the previous page, this network topology consists of several network devices connected to a switch, which manages the network and acts a communications conduit. The switch in turn connects to the departmental server, which holds the company database and provides extra computing power to the clients (i.e. personal computers and other devices). The switch also connects to the proxy server, which in turn connects to the internet through a router. Finally, the switch connects to one or more access points, which provide access to wi-fi devices.

In the diagram presented on the previous, the switch is located in both the physical and logical center of the network. In the bottom-left corner, the two printer icons and the one user icon represent the checkin/checkout area; the one user represents Lisa Sung, who handles appointments, but other users could also be permanently stationed in this area. In the top-left corner, the diagram depicts the server room, which has the router, the proxy server, and the main server for New Century. In the top-right corner, the diagram depicts the office, where each remaining member of the office staff has their own personal workstation. In the bottom right corner, the eight members of the medical staff who receive their own workstation are depicted. Below them, the three nurse work stations are also depicted. Additionally, one connection to a wireless access point is depicted, though in reality more will be added depending on the actual physical layout of the office. Assuming that each nurse station requires five ports, the two servers each require a port, the wireless access points each require one port, and each of the remaining work stations and printers require one port each, the total number of ports that the switch must accommodate is at least 37, although further ports will be needed depending on the number of access points.

**Wireless Network Benefits and Drawbacks**

A wireless network could provide a couple of advantages, but it also has drawbacks. It would eliminate the need for cables, allowing for lower installation costs. A network fully geared towards wireless could also potentially allow for easier integration of various mobile devices. However, the wireless network would require that all computers have wireless capability that is fast enough to support system functions. Additionally, the wireless network could pick up interference from appliances such as microwaves and devices such as Bluetooth. Wired networks tend to have less connection issues, whereas connection issues with a wireless network could potentially prove frustrating. A wireless network could also potentially be more vulnerable to security threats, especially if a user gives away their password. Ultimately, I would recommend against a fully wireless network.

**System Design Document**

The information system will consist of four main modules. The appointments processing module will process appointments, ensuring that medical personnel are not double booked and that patients are scheduled for valid dates and times. The payments processing module will process payments from insurance companies and patients and generate data on payments owed. The record processing module will allow employees to maintain updated records on employees, patients, insurance providers, and other groups. The report processing module will support weekly and monthly reports, including payroll reports, insurance provider reports, and other reports. The user interface for these modules is provided in the attached Microsoft Access file.

New Century’s devices will be arranged in a star pattern, with a central switch managing the network. This will accommodate the 36 ports required for computers, printers, and other aspects of the network, such as the server and the wireless router. Additionally, the network will also support several wireless access points, which will allow New Century to make use of mobile devices.

The information system will support 19 medical personnel and 8 members of the office support staff. Additionally, patients will be able to update medical information and schedule appointments online by using the system. The system must function during normal business hours without excessive slowdown during peak hours. It must support the ICD-10 procedure coding system and interface with 25 California health insurance providers. The system will also support the clinical applications of Electronic Medical Records, Computerized Provider Order Entry, and a Clinical Decision Support System.

The system will handle all the data necessary to New Century’s operations. Information regarding patients, employees, employers, and insurance companies will be tracked. With this data, the system will generate reports daily appointment and call lists, weekly, provider and insurance company reports, and monthly patient statements and claim status summaries.

Programming and testing the system will require 12 weeks. I will hire two other programmers to ensure that the system will the system is fully tested and functional. During the testing phase, we will ensure that each module works as expected and correctly interfaces with the other modules. After that, the main portion of training will take roughly two weeks, as I guide the staff in the use of the new system. Each group of employees will be trained together so that they understand the key components of their assigned systems, while the office support staff and the management will receive extra training so that they broadly understand how most of the systems work. Once that initial training phase is complete, I will continue to provide maintenance and training until 3 months after installation.

As New Century is developing the system in-house, the total cost will be $36,350. Hardware and network installation costs, which would be a factor even if the company had chosen to buy a vendor’s package rather than developing its software in-house, will total to $12,500. Training and maintenance will cost approximately $4550, though this number could go up if more training is required. A flat fee of $2500 will be charged for the purchase of a networked commercial package. The remaining cost of $16,800 will be spent on developing and testing the software. Despite these costs, New Century will recognize significant savings from the system, as it will eliminate over 300 hours of overtime each year and allow New Century to continue operations at its current staffing levels.

**Application Development Tools and Methods**

Since other aspects of this project have relied on structured analysis, I will continue to make use of structured analysis methods and use structured application development. Since we are using structured development, we will make use of DFDs for understanding the different modules of the system and how they connect. Entity-relationship diagrams and flowcharts will also help clarify the connections between different modules. These tools will in turn allow us to build structure charts, which will serve as the key model of relationships between modules. We will also make use of pseudocode in the development of individual programs.

**Structure Chart**



**Testing Plan**

We will begin our testing phase by compiling the programs and looking for syntax errors. After correcting those errors, we will move on to desk checking in order to spot logic errors. All three programmers will participate in code review, in which we will identify errors and ensure that each program meets a minimum standard. We will also hold a design walkthrough with key New Century personnel to ensure that they approve of the interface and are satisfied with the features included.

With the initial phase of testing complete, we will move on to unit testing. I will create a set of pseudo-appointments for the system. Bill Miller will be charged with entering in the appointments. Celia Goldring will then review the data to ensure that it was entered into the system correctly. After this, we will move on to integration testing. We will again enter the data, this time checking to see if it correctly updates the calendar. After performing similar unit and integration tests on other aspects of the system, we will move on to system testing. We will test each individual module, ensuring that all data accurately and correctly flows between different modules.

**Training**

There are three key groups to train: office support staff, primary care physicians, and the medical staff as a whole. All groups will be trained in key aspects of the system, such as navigation of the user interface. In the first session, we will give all groups a general overview of the system, answer questions we expect will arise, and familiarize all groups with the user manual. The medical staff will be trained in accessing and understanding patient medical records. The primary care physicians (along with the office manager) will have a separate session in which they will get be shown how to use the other functions of the system, such as creating appointments, to ensure that they are satisfied with how these systems work. The office support staff will receive the most training, and each individual will be trained in how to accomplish basic functions such as creating appointments and updating patient records. After that, we will individually with each member of the office staff to ensure that they understand how to accomplish the core functions of their job.

**Slow Response Time Memo**

Various issues can cause slow response time, and systems analysts have developed tools and vocabulary for understanding and measuring performance. Response time refers to the overall time between a user action and the system’s response to that action. Bandwidth refers to the amount of data that can be transferred through the system in a fixed period in optimal conditions. Throughput also measures that amount of data transferred through the system in a fixed period, but the term is applied to specific circumstances rather than optimal conditions. Throughput is a major component of response time and is often the cause of slow response time. It is likely that New Century suffers from low throughput at certain times, causing the poor system response time. New Century may need to engage in capacity planning to determine the workload that the system needs to support during the periods of slow-down.

**Maintenance Memo**

There are four major types of maintenance. Corrective maintenance finds and corrects errors in the system. Examples of corrective maintenance include debugging a program that is working incorrectly or restoring wireless network configuration settings to working order. While corrective maintenance can be proactive, it is often reactive to user-reported errors. New Century Wellness Group’s maintenance request form is generally used to request corrective maintenance. In performing corrective maintenance, I determine the cause of the issue, analyze the issue, and devise a permanent solution.

Adaptive maintenance refers to maintenance that adds new features or capabilities to the system. Adding the ability to support mobile devices to an existing system would be one example of adaptive maintenance. Another example would be adding a new data entry field to New Century’s forms. Minor adaptive maintenance, like the example of the new data entry field, can be performed relatively quickly, but major adaptive maintenance requires considerable time and resources.

Perfective maintenance involves changing the system to make it more reliable or efficient. While adaptive and corrective maintenance is often initiated on the request of users, perfective maintenance is generally done without users directly requesting it. However, perfective maintenance is often a response to user complaints about system performance. Example of perfective maintenance include the installation of a more powerful network server or a faster wireless network.

Preventive maintenance reduces the possibility of system failure. Examples of preventive maintenance include the installation of anti-virus software and the development and use of data backup procedures. Preventive maintenance involves the anticipation of where trouble may occur and actions to minimize those issues.

**Maintenance Release Methodology**

Maintenance release methodology is a way of keeping track of maintenance changes and updates. It represents an alternative approach to simply implementing non-critical updates as soon as those updates are ready. Under this methodology, several minor updates are collectively installed as part of a new version of the system known as a maintenance release. Each maintenance release has documentation related to the updates. The methodology does not apply to critical, system-breaking issues; in those cases, fixes are implemented as soon as possible.

Maintenance release methodology is useful in that it results in fewer versions of the system, less installations (and thus less disruptions of users), and less documentation burden. It can also be useful for testing the implementation of more than one update at once, since at times different updates can present unexpected conflicts. Maintenance release methodology is especially useful when multiple teams perform maintenance work on the same system. The downside to maintenance release methodology is that it delays the implementation of some updates. I would recommend that New Century avoid maintenance release methodology, and simply fix issues as soon as possible. Because there is unlikely to be more than one team working on New Century’s information systems, maintenance release methodology would not provide many advantages while also delaying the implementation of updates.

**Security Concerns**

Security presents one of the dominant concerns for any information system. It can be helpful to divide security issues into six categories: physical, network, application, file, procedural, and user. Physical security refers to the actual physical security of the network’s computer equipment. New Century must ensure that the dedicated server room is accessible only to authorized personnel. Additionally, New Century should use passwords on user terminals so that only designated users can access the terminals. Additionally, New Century should have an alarm or surveillance system in place so that the physical hardware cannot be tampered with during non-business hours. Other physical security measures that New Century should take include marking the company’s name and address on each major piece of equipment and requiring fingerprint readers for any mobile devices used to access the system.

Because network traffic can be intercepted, network security is also important. The wireless network must have a form of network encryption to ensure that any intercepted traffic, which could include sensitive information such as credit card information, is not useful for attackers. The most recent wireless security enhancement, WPA2, should be used to encrypt information. The company firewall will also be an important aspect of network security, as it can protect against internet-based threats such as denial of service attacks and port scans.

Because New Century has several server-based applications, application security is an important component of New Century’s overall security plan. Applications should have the proper permissions to guard against unauthorized employee access to sensitive material. Any future features should continue to make use of input validation Careful tracking of application logs can ensure that applications are not being misused in other potentially dangerous ways.

New Century will have access to important information regarding employees and patients, and the security of this information is very important. Most modern operating systems have built-in encryption features to protect against unauthorized access. New Century should make use of this encryption, as well as carefully-planned user permissions. User permissions ensure that users only have access to the files needed to complete their work. Additionally, New Century should make use of individual user passwords that are at least moderately complex and are changed regularly. These various measures will protect confidential information.

Perhaps the most important form of security is procedural security, which addresses many of the day-to-day procedures of the firm. For instance, instead of simply throwing away paper documents, they should be shredded. Both electronic and physical documents should be stored in securely. When performing large-scale data backups, only authorized users should have access to the data.