Rutgers Newark College of Arts and Sciences
&
New Jersey Institute of Technology

CIS 491 Fall 2004

Computer Science Senior Project

Abacus Biocomputing Systems: Content Management Module

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Introduction

1. INTRODUCTION

The goal of this project is to design and create a Content Management Module for Abacus Biocomputing Systems. Our objectives will focus on the management of website advertising, medical device product information, an online shopping cart for purchases on the site, a news feeder which will provide industry related news and a forum designed to create an online community among registered users. We will be one of four teams this semester working towards creation of this e-commerce based start up company whose focus includes the effective use of biomedical devices. Using existing source code our team will merge and customize said code to meet and potentially exceed our sponsor's expectations. In addition to the aforementioned goals our team will contribute our collective creative abilities to go beyond the technical objective. We intend to accomplish this through a front end design and company logo which will impart the spirit of this newly formed organization.

1.1 ABSTRACT

Abacus Biocomputing System (ABS) is a startup company focusing on web-based delivery of healthcare solutions revolving around proprietary computational algorithms. As a first test of clinical utility of the company's computational methods, ABS is developing "Predictive Patient Compliance Tools" for enhancing the accuracy and efficiency of the existing questionnaire-based tools that require time- and resource-intensive patient interviews. The goal of our predictive patient compliance tools is to improve the effectiveness of assistive devices and equipment used to treat ambulatory patients (e.g. hearing aids, wheel chairs, glucose sensors for diabetic self testing). This application addresses a significant problem in health care delivery. Of an estimated $5 billon spent annually on assistive technologies used to improve patient health and well-being, 30-40% is wasted due to patient noncompliance. In addition to this resource drain, an additional cost burden is placed on the healthcare system by the need for additional diagnostic and therapeutic interventions required to treat the noncompliant patients. We believe that demonstration of improved correlation of predictive information with patient outcomes represents an attractive strategy for achieving awareness, acceptance and adoption of web-based tools for delivering healthcare solutions.

1.2 TEAM ROLES AND RESPONSIBILITIES

	Name	Team Role	Responsibilities
1	**Nolan Castillo**	Project Manager	Manage Team Members and Project Deliverables, Communicate with Sponsor, Project Management documentation, Work Breakdown Structure, Gantt & Pert Charts, Economic Feasibility
2	**Vincent Mustacchio**	System Analyst & Back-End Design	Stakeholder Identification, Gathering Requirements, Mapping Requirements, DFD, Feasibility Studies
3	**Dariusz Bystrowski**	System Analyst & Front-End Design	Gathering Requirements, Mapping Requirements, DFD, Testing, User Interface Design
4	**Monis Talib**	Programmer & Architectural Design	Architectural Models, Object Oriented Design, Sequence, Collaboration and State Transition Diagrams, Programming and Implementation, Feasibility Studies
5	**Max Das**	Back-End Design	Database Design, ERM, ERD, Process Specifications, Data Dictionary, Decision Tables
6	**Alex Korczynski**	Front-End Design	User Interface Design, Implementation, Prototype Design, Programming

Table 1

1.3 BACKGROUND – What is wrong with the "AS-IS" system?

Considerable examination of the "AS-IS" has lead us to the conclusion that the system flaws are predominantly due to a lack of efficiency and convenience while it is found to have limitations. This phone or catalog based system allows for the user to place orders from a supplier; however, the human interactions increases the chances for inconsistencies in the order placement. On a phone based system there is no visible order form to review the order for its correctness and with the catalog based system inconsistencies can be contributed to the data entry of the order received by mail into the suppliers system (whether that is an error in the entering of the information or an error in reading the order sheet correctly).

Also there is a lack of convenience in either having to call a supplier and wait to speak to a representative who the healthcare provider would convey the order to or in a catalog system that the healthcare provider would have to wait for the order form to reach the supplier through the mail. Due to the inconveniences of both systems healthcare providers tend to use both systems in which for a sudden priority they would use the phone system to receive the device in a more timely fashion and considering that the order is small this would decrease the chances of a mistake. While for the routine monthly orders of which is larger in size they would use the catalog based system anticipating that the devices would not be delivered until a certain time. However this in itself is a grave inconvenience. Why juggle between two different systems, two separate suppliers depending on what the user may be ordering?

As a final point there is the consideration of the system's limitations. Each supplier deals with a particular medical field or even only with a particular product (e.g. Wheelchairs). To even further limit to the scale of the supplier's system it will often only offer the products of a few select manufacturers excluding some of the less known companies. Now the healthcare

provider is exponentially inconvenienced with having to deal with the possibilities of placing orders with one supplier for a particular product and another supplier for other products that he/she may need. Additional, the healthcare provider does not receive a chance to peruse the various manufacturers of that product.

All in all these major disabilities of the “AS-IS” system encourages the production of a new system that could alleviate the mistakes of its ancestor.

1.4 PROBLEM STATEMENT

The exponential incorporation of technology in the medical profession can be taken one step further. The future system we are designing and attempting to implement has the objective of easing the daunting tasks that healthcare providers have become accustomed to tackling at different times. The job of healthcare provider does not stop at just treating patients; in fact, they have a never-ending education process. This process involves keeping up to date with new procedures, devices, prescriptions, and aliments that are discovered. The overall routine is providing necessary, affordable, state-of-the-art solutions to their patients. What would make the life of the Healthcare provider simple is an entity that provides multiple aspects at once. If the Healthcare provider can go to a single source where he/she will be capable of purchasing/reviewing medical devices, reading new research findings and published reports, and check up on medical news. On the other hand, why stop there.

Why not also provide tools that will effective assist the healthcare providers with their medical rounds? The system will have a tool that with the input of key data, recorded during patient interviews, a projected action is presented. This would eliminate some of the headaches that come with the job and maximize the time and convince factor.

1.5 METHODOLOGY

Methodologies are simple and comprehensive approaches which guideline as to how the project will be developed. Methodologies are used and chosen in such a way as to guarantee maximum efficiency and proper results during product development. Different methodologies include Waterfall Model, SCRUM, COTS, Prototyping, Spiral model and other variations.

1.5.1 Waterfall Model

The Waterfall model describes a method of development that consists of 6 phases. These phases are Requirement Analysis, Preliminary Design, Detailed Design, Code and Unit Testing, Integration Testing and System Testing in that order. At the end of each phase the development team can cycle back to the previous phase before moving on to the next in order to maintain quality assurance (QA). The waterfall model describes a development method that is linear and sequential.

The advantage of the waterfall model is that it allows for isolation and controls of each phase of development. Each component can be individually organized and controlled allowing for easy time management. There is no overlapping or redundancy. Time is very efficient in the model.

The disadvantage is that there is no fall back if it is later determined that revisions are necessary. Once a stage is complete there is no recourse.

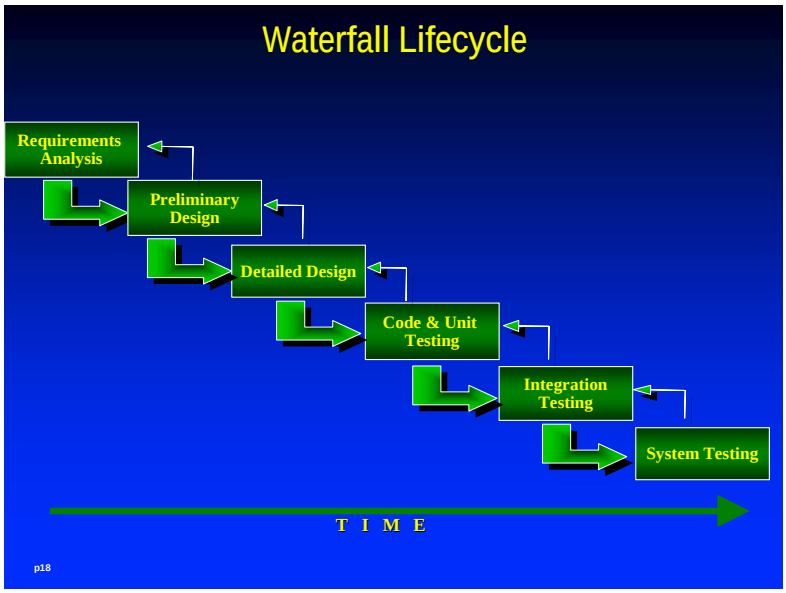


Figure 1
http://sern.ucalgary.ca/courses/SENG/623/W02/18

1.5.2 Scrum

Scrum is an agile, lightweight process that can be used to manage and control software and product development using iterative, incremental practices.

- Scrum is an agile process to manage and control development work.
- Scrum is a wrapper for existing engineering practices.
- Scrum is a team-based approach to iteratively, incrementally develop systems and products when requirements are rapidly changing
- Scrum is a process that controls the chaos of conflicting interests and needs.
- Scrum is a way to improve communications and maximize co-operation.
- Scrum is a way to detect and cause the removal of anything that gets in the way of developing and delivering products.
- Scrum is a way to maximize productivity.

- Scrum is scalable from single projects to entire organizations. Scrum has controlled and organized development and implementation for multiple interrelated products and projects with over a thousand developers and implementers.
- Scrum is a way for everyone to feel good about their job, their contributions, and that they have done the very best they possibly could.

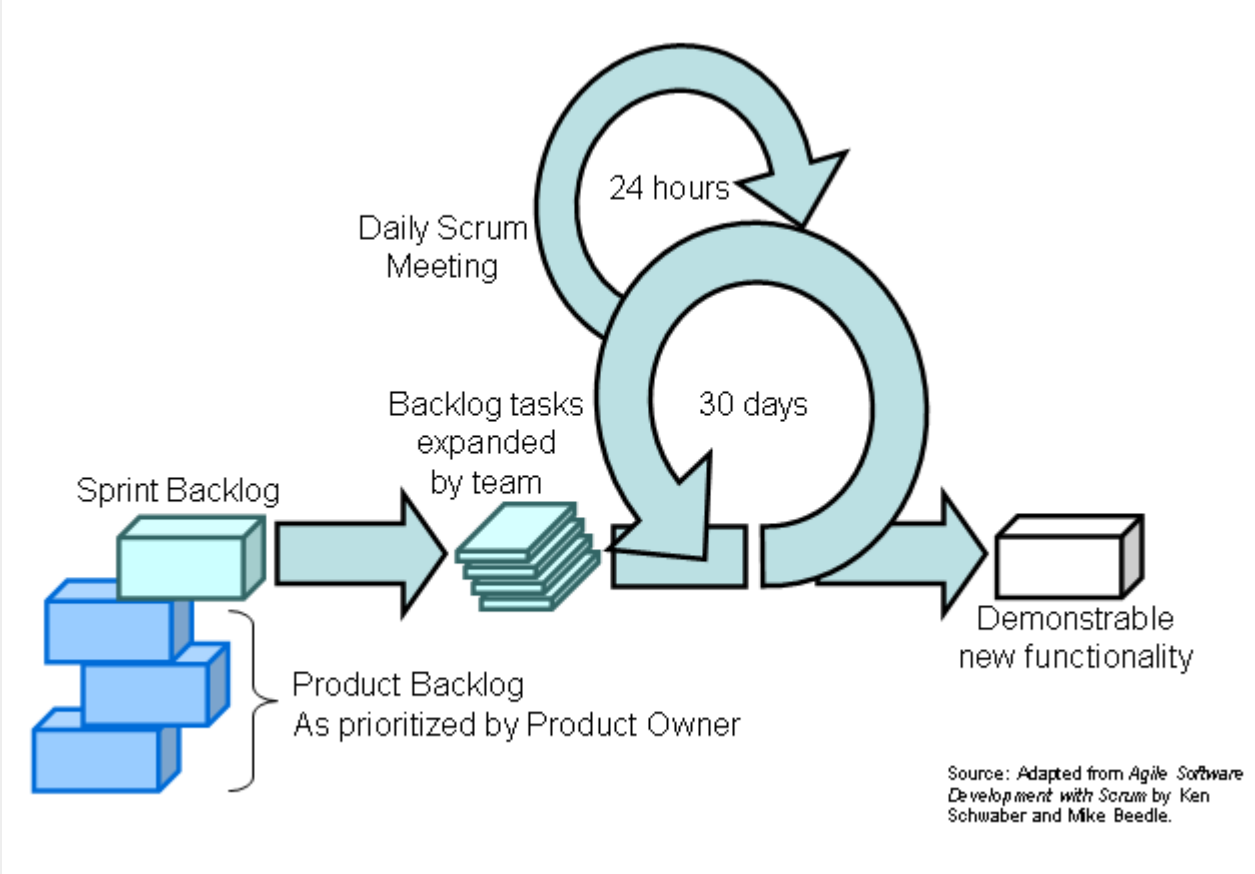


Image courtesy of Mike Cohn [3]

Figure 2
http://dotnetjunkies.com/WebLog/darrell.norton/articles/3910.aspx

Disadvantages

- Built-in instability
- Self-Organizing project teams

- Overlapping development phases
- “Multi-learning”
- Subtle control
- Organizational transfer of learning

http://dotnetjunkies.com/WebLog/darrell.norton/articles/3910.aspx

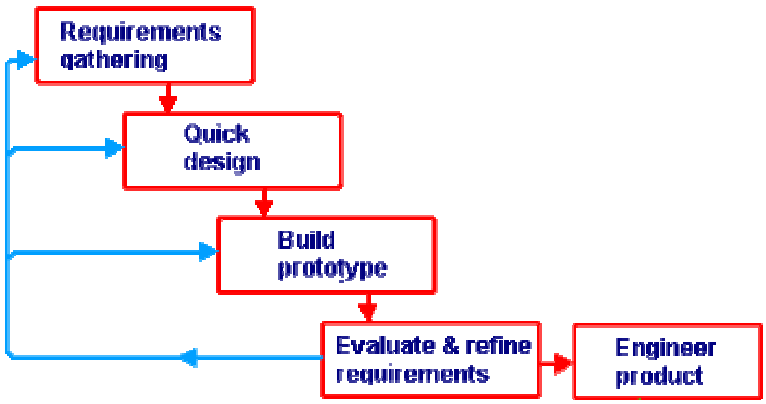


Figure 3
http://www.cems.uwe.ac.uk/~tdrewry/Lifecycl.htm#Prototyping

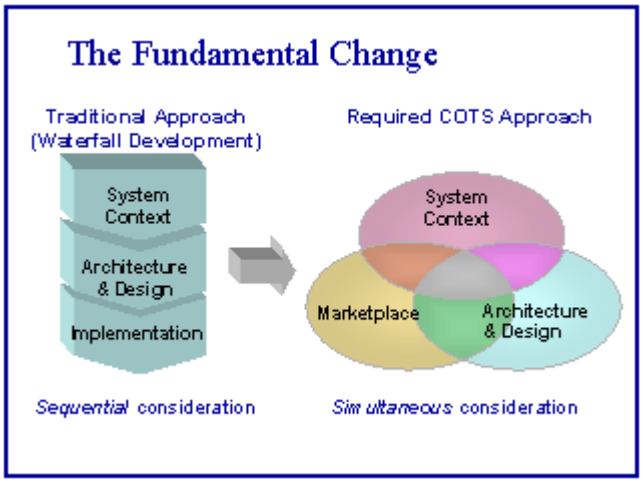
Advantages

- Improved productivity in software engineering and (possible) reduction in costs
- Complete rewrites of prototype software allowing (possibly) a more exploratory approach
- Improved documentation
- Smaller development teams

1.5.3 COTS Based Development

COTS (Commercially Off The Shelf) is a development methodology which uses existing software code to design and implement large scale systems. COTS based systems are much more efficient in that they do not require that every function be redeveloped when they already exist. COTS allows development teams to make great strides within short amounts of time while providing the stakeholders with a robust array of features.

Figure 4



Some disadvantages to using COTS are that some features maybe difficult to integrate or be altogether incompatible. Also there is the issue of intellectual properties to consider. For our purposes our team found “Open Source” code which doesn’t require the purchasing of licenses which could drive up the cost of the project.

1.5.4 Spiral Model

The spiral lifecycle model is the combination of the classic waterfall and Risk analysis. It functions in four phases Planning, Risk Analysis, Engineering and Customer Evaluation. The

Planning phase is where objectives, alternatives, and project scope is set. Risk Analysis as the name implies examines risks, where they are identified and analyzed. If there is a reasonable degree of uncertainty a prototype can be used to assist in determining the course of the project. Customer Evaluation is where the customer will judge the project and determine whether it meets the specific needs or not. Customer Evaluation can take place during any phase, which involves prototyping, in order to insure that the project is moving in the right direction.

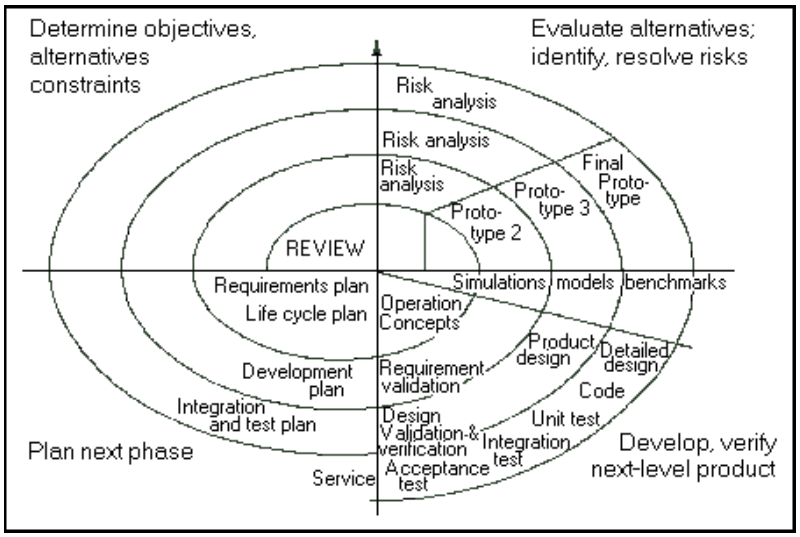


Figure 5

Advantages of the Spiral Model:

- Good for large and complex projects
- Flexibility to react to risks at each level
- Quality Assurance

Disadvantages of the Spiral Model

- Some may not trust that the organization is sound
- Needs considerable risk assessment
- Some risks escape detection

1.5.5 Methodology Decision Matrix

Criteria Model	Risk	Time	Complexity	User Involvement	Total
Spiral	10	15	12	15	52
Waterfall	15	12	12	15	54
COTS	20	10	10	7	47
SCRUM	10	20	15	15	60

Table 2

From the decision matrix above we have concluded that COTS is the best choice for the methodology of this project. This is because COTS can greatly reduce the development time and user involvement while keeping the complexity in check. COTS possesses a high risk factor as the technologyies we would be using might not have been implemented adequately. In implementing COTS we will use our best efforts to reduce the risk factor by using only those technologies that are well documented and have been tested extensively in the industry.

1.6 LITERATURE REVIEW

Our team researched and analyzed several popular biotechnology resources commonly used to get information on how to treat aliments. The first was WebMD.com

Review of WebMD.com

Advantages: WebMD.com is a very popular site for people who have questions such as how to treat a cold or sprained ankle. Key advantage of the site is its ease of use. WebMD features a message board on which visitors to the site can post replies to topics raised, thus establishing an online community. Using the message board encourages an exchange of information.

Figure 6

A disadvantage of the site is its constant pop-up advertisements that can clutter-up the view when a user is trying to access information that they require. This may also confuse

individuals and reroute them from their primary objective to use the site as a biomedical resource. Another disadvantage is that once you obtain the information you require relating to the treatment of said condition, you as the user must now seek the products for that treatment elsewhere. And finally providing patients with the information may result in removing the physician from the solution to the problem by allowing patients to self diagnose.

Review of Home Medical Supplies

A Second site we focused on was "Home Medical Supplies" (http://www.home-medical.net/). This site also shares similar goals in delivering assistive devices to patients and doctors. The site's home page has a wide variety of categories helping the users navigate through the site quickly and effectively thus allowing them to find the products that they are looking for. There are no pop up advertisements cluttering the screen.

Figure 7

The obvious disadvantages are that there are no services offered beyond the simple purchasing of products. The site redirects customers to other websites to complete actual transaction. Since the site uses several third party suppliers it may be difficult for a customer to purchase multiple items if they are located on different websites.

Review of MedicineNet.com

Advantages:

The final website we examined was MedicineNet.com. This site is found to be very informative and well organized. The site is broken down in tabs labeled Diseases & Conditions Symptoms & Signs, Procedures & Tests Medications and Med Terms Dictionary. Within the tabs the various subjects are organized alphabetically and then coupled with a search tools and focused topics scroll down box allows the site to provide a wealth of knowledge on a large variety of health related issues.

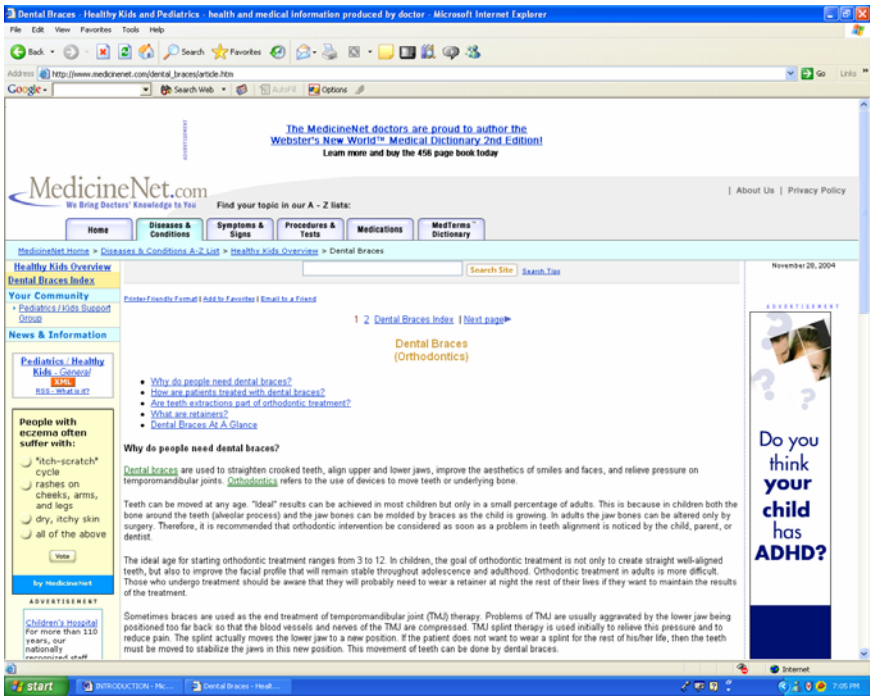


Figure 8

Disadvantages:

Provides patients with such a wealth of information that it may confuse those who may show symptoms of a particular illness or condition and cause them to attempt to alleviate their discomfort on their own, possibly exacerbating the condition. Limiting the types of users who frequent the site is one solution and advising strongly that professional physicians should be consulted before any sort of treatment is attempted is another solution. Also this site offers no way for an individual to better know what treatment is best for their own set of circumstances. For example, if a small-medium back brace would adequately assist a 70 year old 5ft woman weighing 95lbs with chronic back problems or whether a particular treatment is appropriate at that stage of a person's life.

Our collaborative goal in designing the website for ABS is to encompass the better qualities and features of the other sites we reviewed and to add features which result in benefits to our target users. ABS is p+-ioneering the delivery of personalized healthcare products and services.

1.7 GLOSSARY

ABS – Abacus Biocomputing System, sponsor for whom the website is being developed.

Actor - An external entity that interacts with the system.

Analysis - A set of activities that attempts to understand and model the customer's needs and restrictions.

Computer-Aided Software Engineering (CASE) - "Software tools that provide automated Support for some portion of the systems development process."

Context Diagram - An overview of an organizational system that shows the system boundaries, external entities that interact with the system and major information flows between the entities and the system.

Cookie - A small file or part of a file stored on a World Wide Web user's computer, created and subsequently read by a Web site server, and containing personal information (as a user identification code, customized preferences, or a record of pages visited).

Copyright infringement - Situation when another company or individual violates the copyright laws by producing a product, etc. that a company or individual has an existing copyright for.

Copyrights - The exclusive to print or produce a particular product, given for a limited number of years to a company or individual.

COTS – Commercially Off The Shelf, a methodology used for the software development life cycle.

Data Dictionary - Provides simple definitions for each data element in the neighborhood Base application.

Data Flow Diagram DFD - Show how the flow of data from external entities into the system, as well as logical storage.

Economic Feasibility - A process of identifying the financial benefits and costs associated with a development project.

Entity Relationship Diagram (ERD) - A graphical representation of an E-R model.

Feasibility Study – Used to determine if the information system makes sense for the organization from an economic and operational standpoint.

Gantt chart – A project-planning tool that can be used to represent the timing of tasks required to complete a project.

Joint Application Design (JAD) - A structured process in which users, managers, and analysts work together for several days in a series of intensive meetings to specify or review system requirements.

Legal Feasibility - The process of assessing potential legal and contractual ramifications due to the construction of a system.

Login screen - A webpage with a username/password interface for users to gain access to secure areas of the website.

PERT Chart - A diagram that depicts project activities and their inter-relationships; PERT stands for Program Evaluation Review Technique.

RSS – Really Simple Syndication is a method of distributing news on the internet.

Stakeholders - A person who has an interest in an existing or new information system.

System - An interrelated set of components, with an identifiable boundary, working together for some purpose.

System Administrator - The individual who is responsible for maintaining the daily operations, systems performance, user access, user information, and security for the system that he/she is assigned to.

Work Breakdown Structure (WBS) – The process of dividing the project into manageable tasks and logically ordering them to ensure a smooth evaluation between tasks.

Project Management

2. PROJECT MANAGEMENT

2.1 RESOURCES MANAGEMENT

2.1.1 Work Breakdown Structure (WBS)

Section I:
Introduction

Table 3

Task	Duration (days)	Start Date	End Date	Team Member(s)
Project Declaration	1 Day	9/04/04	9/13/04	Nolan Castillo
Project Initiation	1 Day	9/15/04	9/15/04	All
Problem Statement	1 Day	9/04/04	9/04/04	Nolan Castillo Vincent Mustacchio
Methodology	2 Days	9/17/04	9/18/04	Nolan Castillo

Section II:
Project Management

Project Team and Roles	3 Days	9/16/04	9/19/04	Nolan Castillo
WBS	3 Days	9/25/04	9/27/04	Nolan Castillo
Risk Management Plan	3 Days	9/29/04	10/02/04	Vincent Mustacchio Dariusz Bystrowski
Feasibility Analysis	2 Days	9/21/04	9/15/04	Nolan Castillo Vincent Mustacchio Monis Talib
First Prototype	15 Days	10/1/04	10/14/04	Nolan Castillo Monis Talib Alex Korczynski

Section III:
System Analysis

Analysis Plan	4 Days	10/15/04	10/18/04	Monis Talib
Stakeholders	5 Days	10/12/04	10/16/04	Vincent Mustacchio
Hierarchy Diagram	2 Days	10/18/04	10/20/04	Vincent Mustacchio
Use Case Diagram	2 Days	10/13/04	10/14/04	Vincent Mustacchio
Requirements Definition	2 Days	10/15/04	10/16/04	Dariusz Bystrowski

Functional Requirements	1 Day	10/15/04	10/15/04	Vincent Mustacchio Monis Talib Max Das
Non-Functional Requirements	2 Days	10/17/04	10/18/04	Vincent Mustacchio Monis Talib Max Das
Requirements Specification	2 Days	10/15/04	10/17/04	Vincent Mustacchio Monis Talib
Data Dictionary	1 Day	10/15/04	10/15/04	Max Das
DFD Diagrams	2 Days	10/15/04	10/16/04	Vincent Mustacchio Dariusz Bystrowski
General DFD	1 Day	10/15/04	10/15/04	Vincent Mustacchio Dariusz Bystrowski
Decompositions				Vincent Mustacchio Dariusz Bystrowski
Second Prototype		11/8/04	11/14/04	Monis Talib Alex Korczynski

Section IV:
Design

Structured English	2 Days	11/13/04	11/14/04	Max Das
Modular Decomposition	2 Days	10/13/04	10/14/04	Monis Talib
Static Object Model	1 Day	10/21/04	10/21/04	Monis Talib
System Structure	1 Day	10/21/04	10/21/04	Monis Talib
Objected Oriented Design	2 Days	10/22/04	10/23/04	Monis Talib
User Interface Design	1 Day	10/21/04	10/21/04	Alex Korczynski

Section V:
Testing

Test Cases	1 Day	11/30/04	11/30/04	Dariusz Bystrowski
Testing	2 Days	12/1/04	12/2/04	Nolan Castillo Max Das Vincent Mustacchio
Resolve Testing Issues	2 Days	12/2/04	12/3/04	Monis Talib Alex Korczynski

2.1.2 Gantt Chart

The Gantt chart is a beak down of the particular step of the project with focus on time management and the interdependencies of the aforementioned steps on each other. Key steps outlined are the development of the shopping cart, user forum, news feeder front and back ends of the website. It is crucial that each member of the team is aware of how completing tasks on schedule will affect the success of the project.

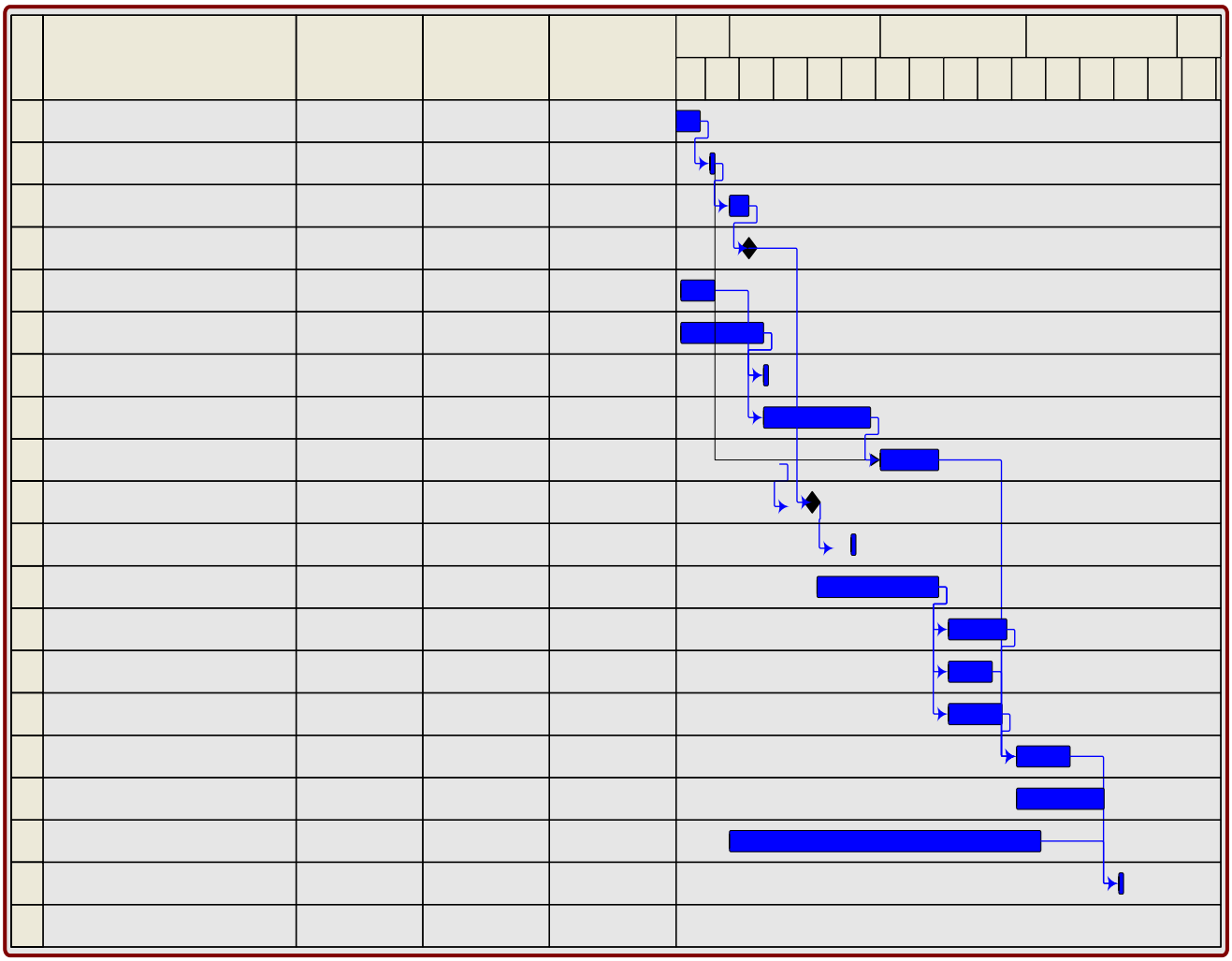
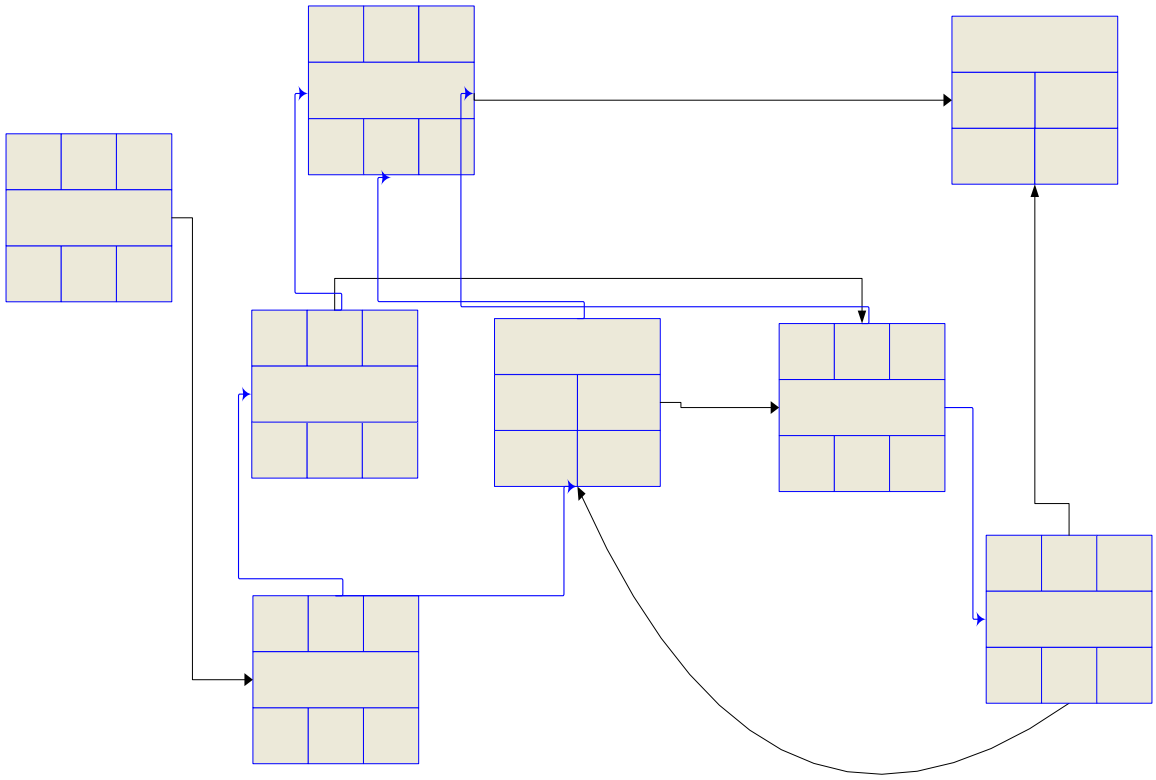


Figure 9

2.1.3 Pert Chart

The Pert Chart functions as a methodology road map which visually details the stages and the order in which our team will perform them in turn to deliver our project milestones, deliverables including final product, and documentation. The stages are very linear, moving from one stage to the next without repeating, except for what I call the development loop which consists of the Requirements Gathering, Prototype and Testing QA stages. During the loop a basic prototype will be developed based on initial requirements gathering and with each cycle through the loop the prototypes will be enhanced and refined until it meets its requirements and passes the testing and QA stage. While cycling through the loop, stages of the development will be documented and the entire project will converge in a robust and well documented Content Management Module.

Figure 10



2.2 FEASIBILITY STUDIES

2.2.1 Financial Feasibility

Table 4 startup

	(t=n)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Totals
Net Economic Benefits		$0.00	$0.00	$250,000.00	$1,200,000.00	$2,600,000.00	$5,100,000.00	
Discount Rate (11%)		0.90090	0.81162	0.73119	0.65873	0.59345	0.53464	
PV of Benefits		$0.00	$0.00	$182,797.85	$790,477.17	$1,542,973.45	$2,726,668.26	
NPV of all BENEFITS	$0.00	$0.00	$0.00	$182,797.85	$973,275.01	$2,516,248.47	$5,242,916.73	$5,242,916.73
One Time COSTS	($260,000)							
Recurring Costs	$0.00	($7,200.00)	($157,200.00)	($325,000.00)	($430,000.00)	($443,000.00)	($456,000.00)	
Discount Rate (11%)	1.00000	0.90090	0.81162	0.73119	0.65873	0.59345	0.53464	
PV of Recurring Costs	$0.00	($6,486.49)	($127,587.05)	($237,637.20)	($283,254.32)	($262,898.94)	($173,758.27)	
NPV of Recurring Cost		($266,486.49)	($394,073.54)	($631,710.74)	($914,965.06)	($1,177,864.00)	($1,351,622.27)	($1,351,622.27)
Overall NPV								$3,891,294.46
Overall ROI (Overall NPV/NPV of all costs)								287.90%
Break-Even Analysis								
Yearly NPV Cash Flow	($260,000)	($6,486.49)	($127,587.05)	($54,839.35)	$507,222.85	$1,280,074.51	$2,552,909.99	
Overall NPV Cash Flow	($260,000)	($266,486.49)	($394,073.54)	($448,912.89)	$58,309.96	$1,338,384.47	$3,891,294.46	

Project Break-Even occurs between years 3 & 4

Acutal Break Even occurred at 4.89 years

1) No revenue till customer subscription (no grant revenue)

2) Investment in development & product ramp up years 1-2 supported by paid in capital, equity investment(s) and/or loan(s) totaling $260K
3) Initial revenue from marketing partners related to billable product launch in year 3 (conservative, as we anticipate advertising & licensing revenues in advance of full scale launch)

4) Revenue growth beginning year 3 includes combination of subscriptions, commissions, advertising, licensing and marketing/distribution agreements
5) "One time costs" estimated as "startup costs," including equipment, facilities, personnel and professional service costs through Series A financing and/or break-even

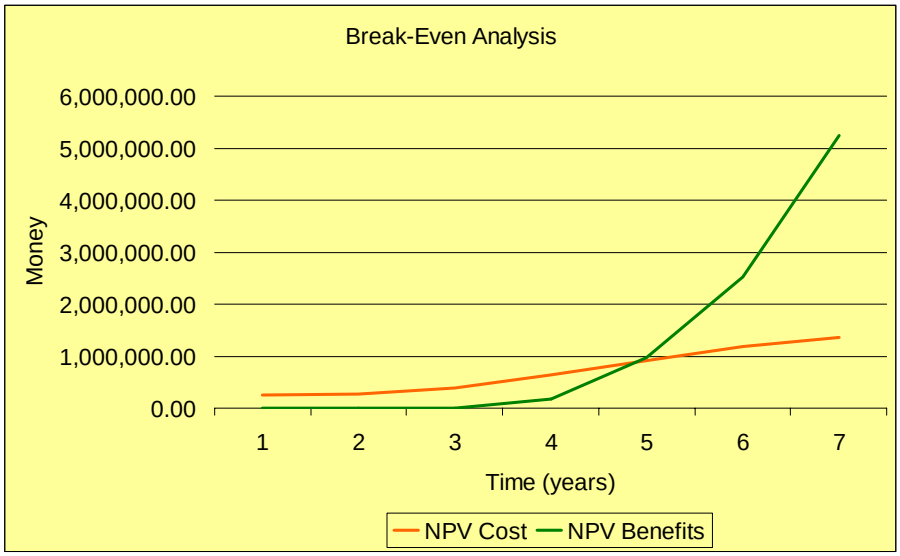


Figure 11

We arrived at the above figures through consultation with Dr Roger Cubicciotti. Dr. Cubicciotti considers these estimates to be conservative. We can not disclose the full figures or how we arrived at these totals in this documentation report due to a non-disclosure agreement that we have signed with ABS.

The key factors to focus on in this analysis sheet are NPV, ROI and BEP. As you will note the ROI (Return On Investment) is approximately 288% at year 6. These numbers are based on NPV cost of $1,351,622.27 and a benefit $5,242,916.73 over 6 yrs. Whenever the benefits outweigh the cost of a project we can then calculate the BEP (Break Even Point) in this project it occurs at 4.89 yrs. Keep in mind that ABS is a start up business and this is still an early stage for the company, the first two years show no economic benefit since the company is still forming. The NPV (Net Present Value) is the value of the money spent on the project at its completion. In order to calculate NPV we use a discount or interest rate of 11% which affects both economic benefits and costs alike.

2.2.2 Cost Estimation

2.2.2.1 Function Points Analysis

Careful and accurate estimation of the project's size is extremely important in order to estimate its cost. The Function Point model estimates a project's size based on the project's complexity and the language used in its development. By using a more object-oriented approach, COTS (Commercially Off The Shelf), we use less time, decrease the project size and simultaneously its cost. There are various factors that have an impact on the project's complexity, and they have to be carefully analyzed. Table 6 clearly shows how those factors are determined.

The information gained from Function Point Analysis such as Total Adjusted Function Point is later used to estimate effort needed for the project in COCOMO model

Function Point Count *Table 5*

Function Counts	Complexity			
	Low	Average	High	Total
Inputs	0*3	5*4	0*6	20
Outputs	4*4	0*5	0*7	16
Inquiries	0*3	0*4	5*6	30
Files	0*7	5*10	0*15	50
Program Interfaces	0*5	0*7	8*10	80

TOTAL UNAJUSTED FUNCTION POINTS	196

Function Point Adjustment Factors

Table 6

Factor	Description	Influence
Data Communication	There will be no significant data communication.	1
Heavy use configuration	There will be no significant heavily used configurations	1
Transaction Rate	Transactional rate is fairly important, since the system will be used as reference.	4
End-User efficiency	The whole system is made to satisfies end-users and to make their work as efficient as possible.	5
Complex Processing	There will be some complex processing.	3
Installation Ease	The system will need to be transferred to ABS server	3
Multiple Sites	Forum will operate in a different window for security purposes	2
Performance	Performance is one of the key issues.	5
Distributed functions	Distributed functions are critical.	4
On-line entry	On-line entries are moderately critical.	2
On-line update	Availability for on-line updates crucial.	4
Reusability	The system will be designed for maximum reusability.	4
Operational Ease	Extremely user friendly	4
Extensibility	The system has many more features and is easily modified	2

PROJECT COMPLEXITY (PC)	44

ADJUSTED PROJECT COMPLEXITY = 0.65 + (0.01 * PC) = 1.09

TOTAL ADJUSTED FUNCTION POINT is equal to the product of adjusted project complexity and unadjusted function point

TOTAL ADJUSTED FUNCTION POINT = 1.09* 196 =213.64

Language	LOC/ Function Code Point
C	130
COBOL	110
JAVA	55
C++	50
Visual Basic	30
HTML	15
SQL	13

To develop our system, we use SQL and HTML, and in order to calculate approximation of number of LOC, we multiply Function Code Point of a language from table and TOTAL ADJUSTED FUNCTION POINT

LOC of HTML
213.64 * 15 = 3204.6

LOC of SQL
213.64 * 13 = 2777.32

2.2.2.2 Cost Construction Model (COCOMO)

COCOMO is a simple cost constrution model for estimating the number of person-months required to develop software. The charts below signify the manpower needed if the system we designed using COTS was written entirely by the team members. Using existing code we were able to accomplish that which would have required many more programmers and developers.

Table 7 shows us how to calculate an estimation of effort, time for development and number of people. Effort is measured in person-month, and it means how many months one skilled person needs to complete the whole project.

Table 7

EFFORT	1.4 * KLOC
DEVELOPMENT TIME = 3 * (EFFORT)^1/3	3 * (EFFORT)^1/3
No. of People	EFFORT / DEVELOPMENT TIME

* effort is measured one person month; meaning time needed for one skilled person to complete the whole project

HTML
EFFORT = 1.4 * 3204.6= 4486.44 DEVELOPMENT TIME 3 * 2777.32^1/3 = 49.4791 No. of People = 90.6734

SQL
EFFORT = 1.4 * 2777.32= 3888.25 DEVELOPMENT TIME 3 * 3888.25^1/3 = 47.1744 No. of People = 82.4229

2.2.3 Technical Feasibility

Measuring technical feasibility involves looking at factors such as project size, project structure, the development team's experience in the subject and the user group's experience with the development project and application area. This project is a relatively large project but it has been structured in a very modular way and distributed to four teams therefore the complexity has been significantly reduced. The only significant factor for assessing the technical feasibility of this project is the experience of the development team.

The task of our project is to build e-commerce tools such as shopping cart, product catalog, forum, newsreader and news syndication. All of these are being used extensively on the Internet everyday. We are not developing any new technology and therefore can rely on the experiences of others to guide us technically in the development of this project.

Furthermore, this project is being developed in PHP with a MySQL database, both of which are open source. Due to this reason, a lot of development has been made using these tools in the open source community. There are many open source scripts available for performing many features that may be needed in this project. The Object Oriented programming obtained in PHP allows for modular use of many simple components of this project. Utilizing these scripts will highly reduce the development time and cost for this project.

The development team is an excellent combination of all skills needed for this project. Our team consists of members who have specialist knowledge in different areas such as programming, web development, database design, system analysis and others. Some are experienced and are working in the industry using the same tools we would use in this project while others are highly gifted in their knowledge of concepts of these tools. Although our team has very limited experience in developing a project of this size, the team consists of six highly

dedicated individuals who are very willing to learn new skills and implement them in the project. Even though it is true that the group members are not experts like others in the industry and have only a limited knowledge of project development processes, they still possess enough knowledge about all the components being utilized in this project.

Furthermore, our team possesses a great advantage because of their academic background and environment. All team members are students and have been in an environment that has required and encouraged learning new knowledge and skills for at least the past four years. Keeping this in mind, the team will approach any new technical skill and knowledge with only the objective of learning and utilizing it to enhance and facilitate our project development process.

According to our technical feasibility study, this project can be viewed as having low-medium risk from a technical perspective. Technical competence will not be a limiting factor for this project.

2.2.4 Legal Feasibility

The legal logistics of the system begins at its most crucial juncture – the protection of sensitive confidential patient information. Abacus will have patient information stored on its system. From a legal standpoint if this information was stolen by an individual who attacked the system, legal action may be taken against the company. Disclaimers must be issued to acknowledge such threats in order to reference that the users understand these risks, allowing ABS to not be held liable. A variation of such a situation would be if the system had a design flaw in which when a user logged in he/she was logged on as a different user, giving this person access to view that person's information. Proper testing has been preformed and this will not occur so this is not a problem that should arise.

As far as the products that Abacus will be providing:

Point One: If a customer claims that they received false information concerning a medical device that they purchased. Abacus must be certain that they attain the correct information from the manufacturer and verify upon entering the information (to be displayed on the site) that human error did not occur in the entry process.

Point Two: One legal advantage is that the products are manufactured by another entity and Abacus can not be held liable for malfunctions or defects.

From a legal standpoint Abacus has and must continue to follow this guideline. The conclusion of our finding is that the system is legally feasible to implement.

2.3 RISK MANAGEMENT

2.3.1 Risk Identification

2.3.1.1 Project

Project Size

The development team of 6 members will design and implement the Content Management Module of the ABS system. This module includes specific features. A moderate amount of hours must be spent on the creation of such features however the degree of difficulty is low.

Time Constraint

Due to the use of COTS time was decreased. The project will be developed and completed over the course of three months. Because this is a startup company there is no existing system and no rush for the completion or effect on other systems if production is delayed.

Project Structure

This company has no existing system in place, but this project is based on the existent system that the health care providers use, the AS-IS systems are phone, catalog, or web-based ordering. Our system will be more user-orientated. The users seem to agree that this system will be one they will use in the future. Abacus has been meeting with health-care providers and others with knowledge of the industry to develop the adequate system.

System Interdependences

Because this company will serve as a vendor, supplying different manufactured medical devices to the users the system depends on the manufacturers upholding their efforts. They will require interaction with the manufacturers' systems. This will involve some level of risk.

2.3.1.2 Familiarities with Technology or Application Area

Development Team

The team members have significant knowledge of the development languages and hardware involved in the project. Additionally, members are familiar with software development environment and have experience of dealing with a project of this size. Other members have knowledge and skills to analyze and plan the correct path to take.

User Group

The users are health care providers, webmasters, and system administrators. The health care providers may or may not have experience with dealing with a web-based ordering system. Some users currently use such a system and will not have difficult navigate this system however those who have no internet experience may have difficulties. The webmasters and systems administrators will be ABS employees who use the administrative areas of the system. These employees should already have computer-based knowledge and will not have trouble in dealing with the system.

2.3.1.3 Business and Requirements

The success of this company depends on this system. If the health care providers use the system, the amount of users will be large. The system will depend on multiple business systems owned by other companies.

2.3.2 Risk Measurement

PROJECT

Duration of Project	1	2	3	4	5
Estimated Size of Project	1	2	3	4	5
Project Effort in Hours	1	2	3	4	5
Flexibility of End Date	1	2	3	4	5
Interdependence to Other Systems in Abacus	1	2	3	4	5
Interdependence to Manufacturers' Systems	1	2	3	4	5

Risk Level For Project: **Medium Risk**

FIMILARITY WITH TECHNOLOGY OR APPLICATION AREA

Team Member Familiarity with Hardware	1	2	3	4	5
Team Member Familiarity with Program Language	1	2	3	4	5
Team Member Familiarity with Software Development	1	2	3	4	5
User Familiarity with new system	1	2	3	4	5
Webmaster Familiarity with Maintenance of System	1	2	3	4	5
System Administrators Familiarity with System	1	2	3	4	5
Implementation Interrupt Critical Business Processes	1	2	3	4	5

Risk Level For Familiarity with Technology or Application Area: **Low Risk**

BUSINESS AND REQUIREMENTS

Resistance to use the New System	1	2	3	4	5
Amount of Users	1	2	3	4	5
Dependent on Manufacturer Supplying the Devices	1	2	3	4	5
Users Staff Availability During the Development Process	1	2	3	4	5

Risk Level For Business and Requirements: **Medium Risk**

2.3.3 Risk Minimization

Following the identification and measurement of the risk involved in this project we can take steps to minimize what we have discovered. Interdependence to manufacturers' systems, user familiarity with the new system, and dependency on the manufacturer supplying the devices were measured to be the risky elements of those identified and so helping to reduce these risks will decrease the overall risk tremendously.

Interdependence to manufacturers' systems is classified as the highest risk of the three. The system you design should never have total interdependence on another system. Especially one that does not involve your company and that you have no control over. However, in the case of this system, there must be some existence of interdependence. Our goal in our system structure was to maximize Abacus' ability to process orders while not having to constantly interact with the manufacturer.

User familiarity with the new system is an aspect, as with interdependence, that can't be eliminated completely. It is expected that some of the potential users may not have visited websites and may have trouble with traversing the site. One way to decrease the risk that users will not understand and will begin to shy away from using the system is to have resources like FAQ to inform the users of general elements of the system and how to operate them. We must strive for a user friendly environment so that the first-time users are not discouraged after their initial experience. Furthermore, this type of risk is interconnected with the risk of resistance to use the new system. Those who are not familiar with this type of system may be susceptible and adapting the use of this system may seem uncomfortable to them. While others who use similar web-based systems may have grown accustomed to the system they use and wish not to switch. This is a risk that must be minimized. In order of drawing users of similar systems we must

develop unique and useful tools that others do not offer – we need to develop a competitive advantage. We also must assure that the system offers effective and efficient delivery of the end product in order for the users to feel satisfied and make them willing to switch to this system.

As for the dependence on manufacturer supplying the devices there are only a few actions that be taken. If the manufacturer is not producing the products at the rapid rate needed, per say, than there will be a loss of a device that could be available. The failsafe for minimizing the damage are: Ensure that multiple manufacturers for a certain device are available, provide up-to-date tracking for the supply that the manufacturer will have available, send alert emails to the users who are often purchasers of a device that is becoming low in supply or an alert email if the Abacus receives notice from the manufacturer that their supply is low, etc. These steps will ensure that the users are either well informed about the situation or well compensated by given a comparable product.

System Analysis

3. SYSTEM ANALYSIS

3.1 BUSINESS MODELS

3.1.1 As-Is System

The AS-IS Systems being utilized by healthcare providers for purchasing medical devices are three separate systems. The type of doctor the individual is and the type of medical device, factor into which system they use. Furthermore, it is not uncommon for a single healthcare provider to be using two or three systems, but it is highly unlikely that one healthcare provider would use all three. The disorganization of the AS-IS System is a key factor for the success of the TO-BE System. The three systems or sub-systems of the overall AS-IS System are a phone-based, catalog-based, and a web-based system. Each system has a distinct style of ordering devices. The web-based system is the easiest way of accessing medical devices and allows the medical professional a wide range of devices to research and purchase. Although it is common to find web-based systems dedicated to a particular device, as for example – wheelchairs, with the phone-based system the medical professional will still be able to converse with the supplier and order various types of medical devices as so long as the supplier carries the device. As for the catalog-based systems, they are made specifically to adhere to a certain specialty and if the healthcare provider wished to order a device outside his/her specialty he/she will have to use either the phone or web based systems.

The general process a healthcare provider will perform would be first to order the device. The supplier processes the order and on the Healthcare providers end he/she will initially pay personally for the device, and then will receive the bill monthly. After ordering the device the doctor's office sends the paper work to the insurance office which will reimburse fully or

partially for that individual order. If there is partial or no reimbursement then the patient has to cover the difference.

3.1.2 To-Be System

The TO-BE System will be a web-based system that will not only provide the ordering access for medical devices but additional utilities. These utilities will be a news feeder and forums to allow healthcare providers to catch up with medical news. The TO-BE system will follow with the structure of popular e-commerce based systems that are presently found. Our team will be altering the code of an open-source shopping cart system in order to customize our needs. From the customer perspective a detailed list of products categorized based on the area of medicine and the device type will be provided. Throughout the site, manufacturer advertisements will be displayed to catch the interest of some of the users. The user will create an account with the system, and then when shopping the user will select the items that he/she wishes to purchase, the user will be presented with a screen detailing his/her order. Options will be displayed such as type of shipping and shipping address, credit card information. Once the options are selected the transaction is processed and ABS will be allowed to access the manufactures website in order to verify the quantity.

For ABS the system will provide the tools necessary to maintain the system while outputting the necessary information such as: products purchased along with the quantity of items, and number of clicks for a particular advertisement.

3.2 STAKEHOLDER IDENTIFICATION

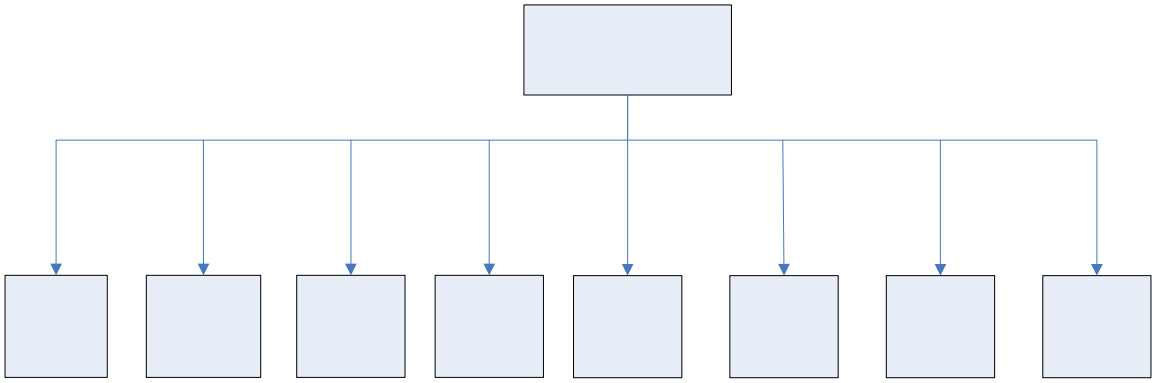


Figure 12

An important process which is required in the initial stages of the development process is the identification of the stakeholders for the system. The stakeholders will have a variety of reasons for being effected by the new system. For this particular project the AS-IS system is something that will not be replaced unless the TO-BE system gains the popularity needed to push the users towards eliminating the old system. Below is the list of stakeholders:

Healthcare Providers

Healthcare Providers are obviously a stakeholder in such a system that is geared towards them. This is to replace their old system of ordering/receiving devices. As for the current goal of ABS there will be a limited amount of medical specialties in which they will be able to provide devices for. However, they are aiming to supply devices for all the healthcare provider specialties in the future. Below is the current list of medical specialists that devices will be available for:

Allergy-Immunology, Anesthesiology, Cardiology, Cardiovascular Surgery, Critical Care Medicine, Endocrinology, Emergency Medicine, Family Practice

Gastroenterology, General Surgery, Hematology, Infectious Disease, Internal Medicine,

Health Care Providers

Device Manufactures

Insura Comp

Medical Oncology, Neonatology, Nephrology, Neurology, Neurosurgery, Obstetrics-Gynecology, Ophthalmology, Orthopedic Surgery, Otolaryngology, Pathology, Pediatrics, Pediatric Cardiology, Physical Medicine and Rehabilitation, Plastic Surgery, Radiology, Radiation Oncology and Therapeutic Radiology, Respiratory Disease, Rheumatology, Thoracic Surgery, Trauma Surgery, Urology, Vascular Surgery, and Surgical Services.

Insurance Companies

The insurance companies will have a stake is this system. The involvement of the insurance will be identical to that which they are performing now with the AS-IS system. They are still an entity of the process and will be a stakeholder in this system's development.

Device Manufacturers

The device manufacturers will be an entity which will feel the effects of the development of the system. ABS will now be providing a service for the device manufacturers. In addition, there will be multiple companies supplying the same product. This levels the field for the lesser known manufacturer, who a healthcare provider might not have heard of through the AS-IS system.

Other Supplier Companies

In the AS-IS system there are supplier companies that are either web-based or catalog-based. The Healthcare providers are currently ordering the devices from supplier companies which are of the same form as the TO-BE system that ABS will implement. The TO-BE system

is online and will supply numerous devices. Researching the current suppliers, none supply the plethora of devices that ABS will. These supplier companies will be the competition that ABS will face.

Patients

The patients will of course be stakeholders as the purpose of healthcare providers purchasing devices is to supply the patients with the device. There will be other aspects of the ABS system that will benefit the patients.

ABS Employees

The employees include the webmaster, forum administrator, order processor and any other employees that will be maintaining the system.

Investors

Abacus Biocomputing Systems is a subsidiary of a larger company. This company is investing money and time into the ABS ideal.

Corporate Members

The founders of the system; Connie Zhou and Roger Cubicciotti are the corporate members of the corporation that are observing and aiding in the construct of this system.

3.3 REQUIREMENTS GATHERING

3.3.1 Traditional Methods

3.3.1.1 Interviews

The results of the interviews with healthcare providers have remained consistent. This has led us to the rightful conclusion. They are willing to try a new system that provides the ability of the multiple systems that they are currently using. The outline below is the list of interview questions and some typical responses.

1. What is the process that you do to order a medical device? What type of system do you utilize: a paper form system, phone system, or web-based or a combination?

   Response from Dr. Thimmel: Catalog and phone system. When ordering the device we follow the supplier's code system that is for that specific profession. This code is also used by the insurance company. This is a universal code.

   This is the same for the majority interviewed. Only two were found to be using web-based systems.

2. How often are items ordered?

   Typical Response: We do inventory once a week and order stock as needed.

3. When ordering devices do you ship directly to a patient or your office?

   Response: They are shipped directly to the office.

   They can only ship directly to the office never to the patient!

4. Do you rely on a single vendor or is there a company/website that supplies many vendors' products?

   Typical Response: We use a supplier that contracts with many vendors.

5. How often do you purchase/prescribe devices outside your specialty?

   Typical Response: We purchase these devices about every 2 to 3 months.

   This was the average for the healthcare providers interviewed.

6. Do you perform the ordering or would one your assistants be performing the tasks?

   Typical Response: The assistant does the ordering.

Insurance Process

7. How are the insurance companies involved? What is the process of interaction between you and the insurance company?

   Typical Response: We bill the insurance company and let the company handle the expenses.

8. Are there times that products are purchased that are not covered under insurance?

   Typical Response: Depends because insurance companies vary.

9. How strict is the insurance company about purchasing products?

   Typical Response: Varies on the Insurance company therefore it is important to find out if the insurance company will cover the device/aid before ordering it. This way, we

can inform our patient of any probable expense they may have to cover and let them decide if they want to proceed.

Billing/Payment Process

10. Do you have an account with the vendor and the billing is handled directly or is it through (personal or business) credit cards?

    Typical Response: We have an account with the supplier. If the insurance company will cover the expense, we bill the company. If not, the patient's credit card is charged or the patient pays in cash.

Feedback for TO-BE System

11. Do they find the use of a web-based purchasing tool useful?

    Typical Response: This office has just begun venturing into the possibility of using a web based online system.

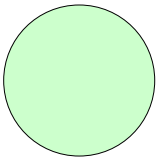
3.3.2 VORD Methods

3.3.2.1 Brainstorming

Categorization

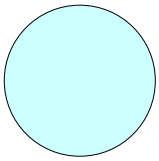
Expandable

- Expandability to All Medical Fields
- Template Design
- Scalable



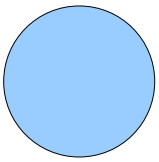
Convenience

- Website Design
- User Friendly
- Email Notification



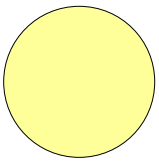
Security

- Secure Authentication
- Information Privacy



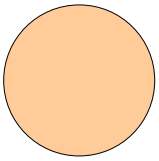
Efficiency

- Platform Independent
- No Browser Preference
- Price Management
- Ad Impression/Click Reporting



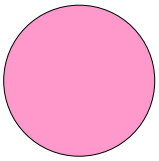
Content

- Product Listing
- Product Images/Information
- RSS News Feed
- RSS Syndication



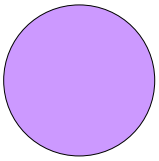
Interactive

- User Comments
- Forums
- Product Reviews



Other

- Credit Card Transaction



3.3.2.2 Quantitative Method ($100 TEST)

	Security	Convenience	Content	Efficiency	Expandable	Interactive	Adaptability	
Healthcare Provider	30	20	20	15	5	10	0	**100**
Webmaster	5	15	0	20	20	0	40	**100**
System Administrator	30	10	0	10	25	0	25	**100**
ABS Executive	15	30	15	30	15	5	20	**100**
Investors	10	15	5	35	15	5	15	**100**
Device Manufactures	20	15	35	10	10	10	0	**100**
	110	**105**	**75**	**120**	**90**	**30**	**100**	

Table 8

Ranking of Properties

1. Efficiency
2. Security
3. Convenience
4. Adaptability
5. Expandable
6. Content
7. Interactive

3.3.2.3 JAD Session

A JAD (Joint Application Design) session is a powerful tool that we utilized in the information gathering stage to quicken the process while maintaining accuracy. Additionally, it allowed the developers to decipher the expectations of the system which we set out to construct.

We performed the JAD sessions in the initial stages of the semester in order to begin with the development process as soon as possible. It was essential that we began the process quickly to ensure the completion of all the expected tools involved in the system. In the first JAD session we had already felt that we made more progress than what we had hoped to accomplish with this technique. We then constructed prototypes with this information and we received optimistic feedback from the executives when presenting them. The first JAD session proved to be a successful adventure and we were inclined to perform another JAD session to discuss the idea of going with another methodology of development and design of the system.

Facilitator:

- Roger Cubicciotti

Executive Member:

- Connie Zhou

Development Members:

- Nolan Castillo
- Vincent Mustacchio
- Dariusz Bystrowski
- Monis Talib
- Max Das
- Alex Korczynski

As a result of the JAD sessions we have identified the most crucial requirements of the system and this had allowed our development team to design some prototypes.

The topics that were touched on during the JAD session:

- Template (Edit and Delete controls for the Webmaster)
- Shopping Cart
- Database Interface
- Login
- Restricted access
- Dynamic Menu
- Advertisement Manager
    - Record Impressions
    - Record Clicks
- News Feeder
- Programming Languages
    - XHTML 1.0
    - MySQL
    - PHP
- Design (Appealing yet professional)
- Convenience
- Security

From the JAD session we discussed the concepts that the executives had for the system, the potential problems of implementation of certain concepts and identified certain situations that were not considered, and from all our interaction developed a solid foundation.

3.3.2.4 Prototyping

To reap the benefits of the initial JAD session our team acted to develop four proposals of the front-end design adhering to the information we gathered. During our next meeting we presented the four prototypes to confirm a path toward our final design. The corporate members identified with one design in particular, citing an appealing color scheme and layout. Alternations were suggested and discussed and from this we were able to produce an upgraded version accordingly.

The crossroad of our design process came when our group opted for a totally redesigned system. However before dismissing out then current design and completely adopting the new version we constructed a prototype and in a subsequent meeting consulted the corporate members of which path they preferred. The latter was chosen and we then once again began a refinement process updating the system with the necessary utilities (news feeder, forums, etc.). Upon completion of each utility we performed a presentation to gather feedback. Additions were suggested and complied with accordingly. The construction conceded various prototypes that were enhanced to achieve the final system. We found prototyping to be a very powerful tool in the design and requirement gathering process.

Here are the first four original prototypes presented in the first meeting:

Figure 13

<u>Prototype 1</u>

Cited to be insufficient with the desires of the corporate image

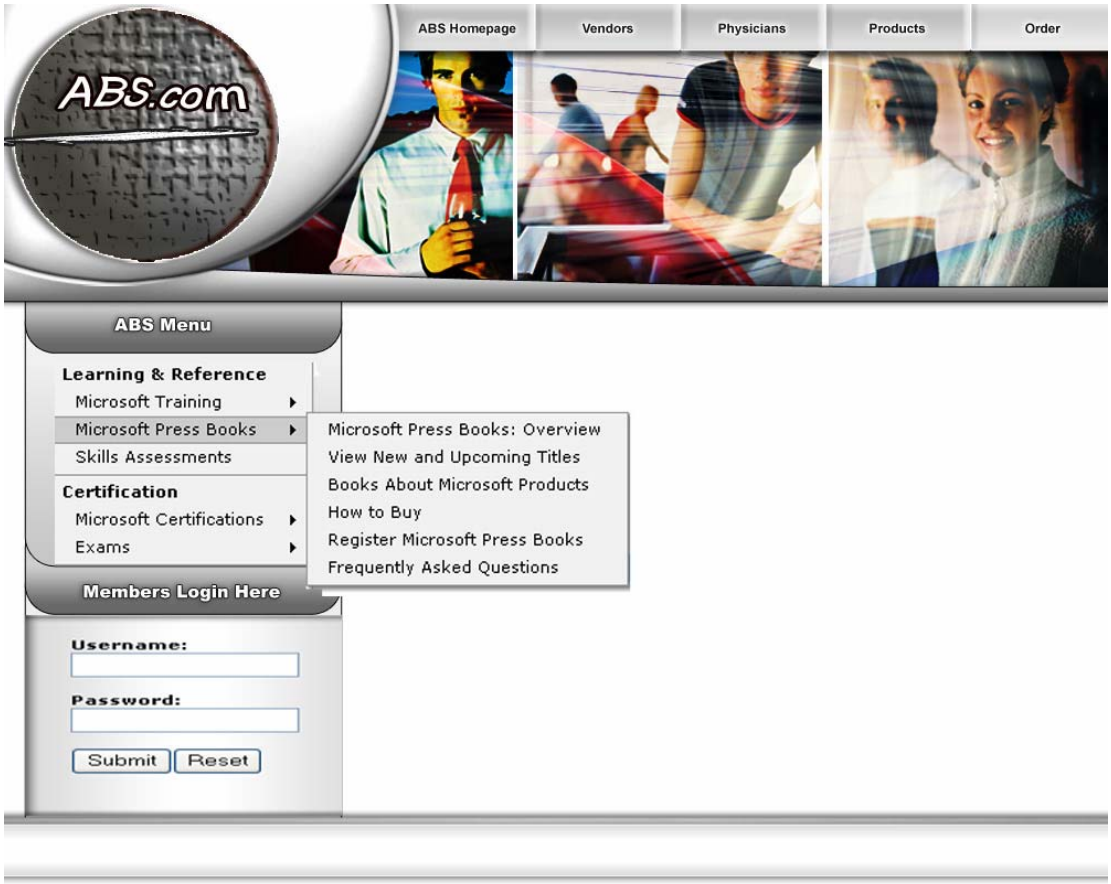
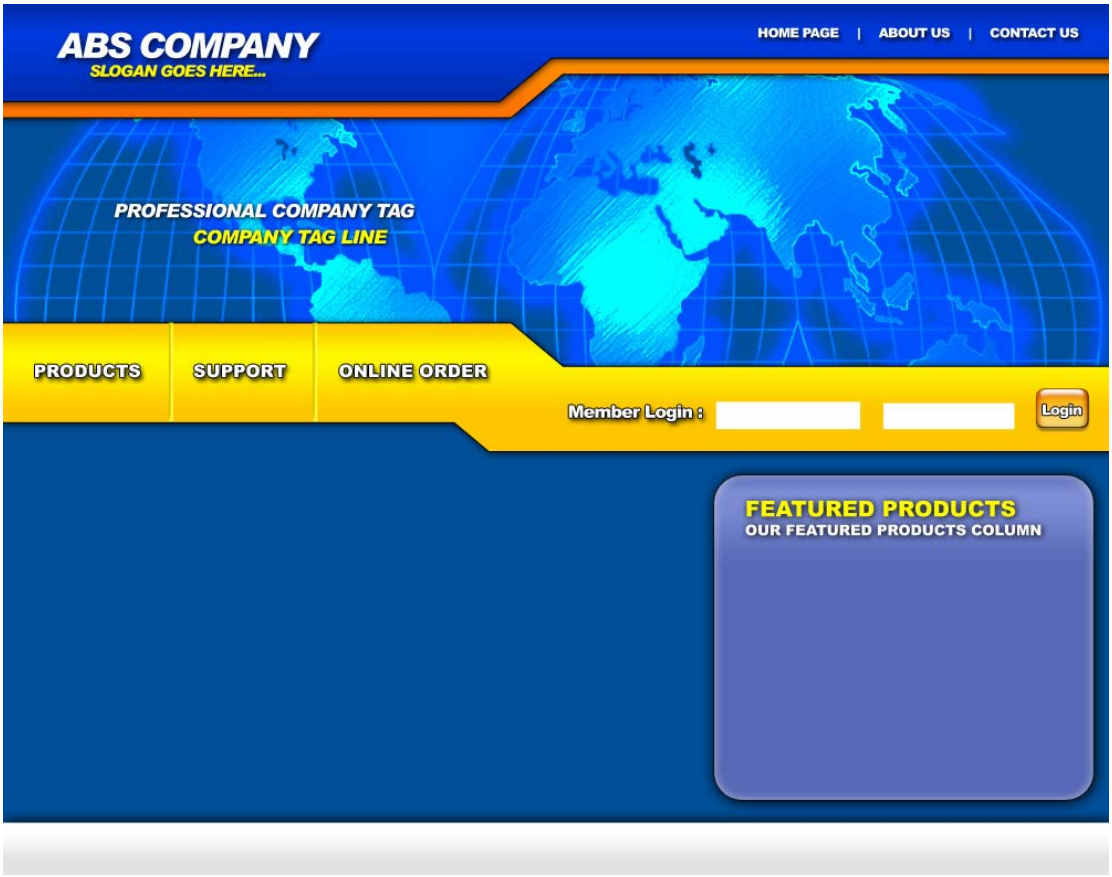


Figure 14

Prototype 2

Cited to be stronger than the first variation; however, it was still consider to be a lesser of the four.

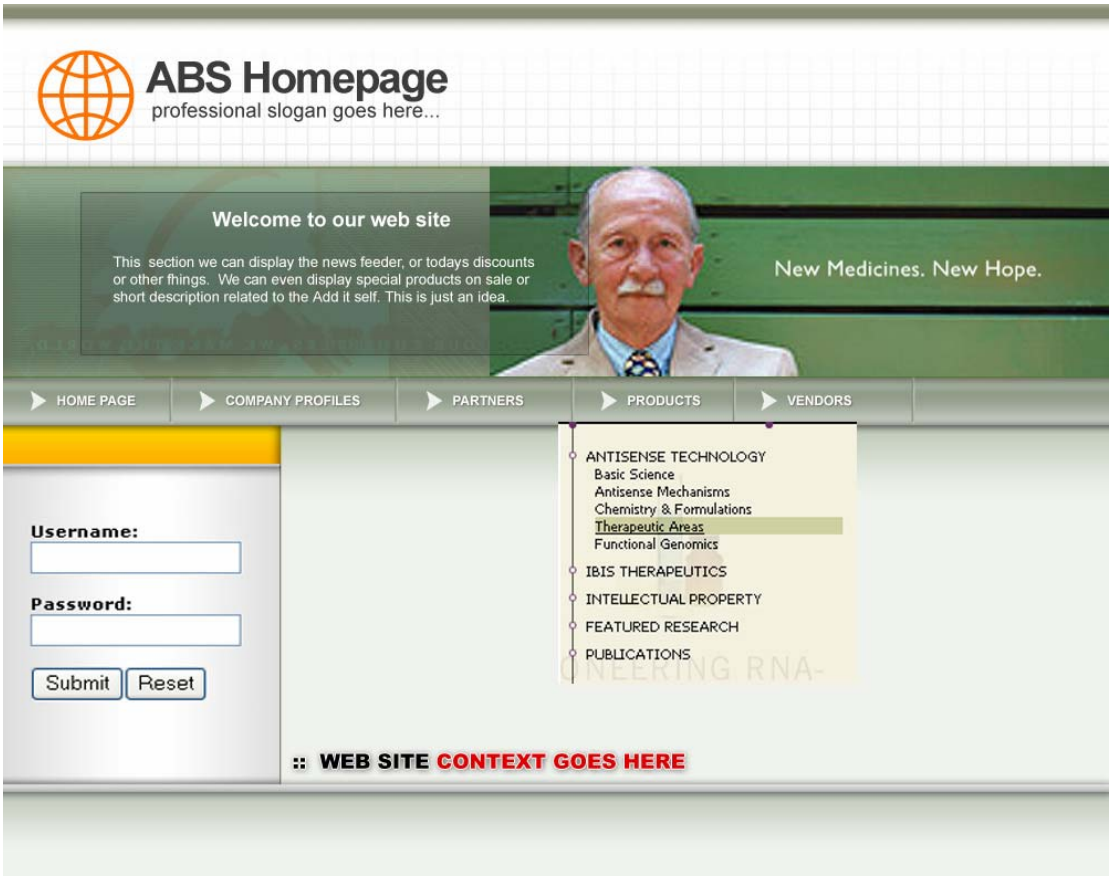
Figure 15



Prototype 3

Cited to be more professional and visually ascetic but the fourth variation was considered to be the preferable design.

Figure 16

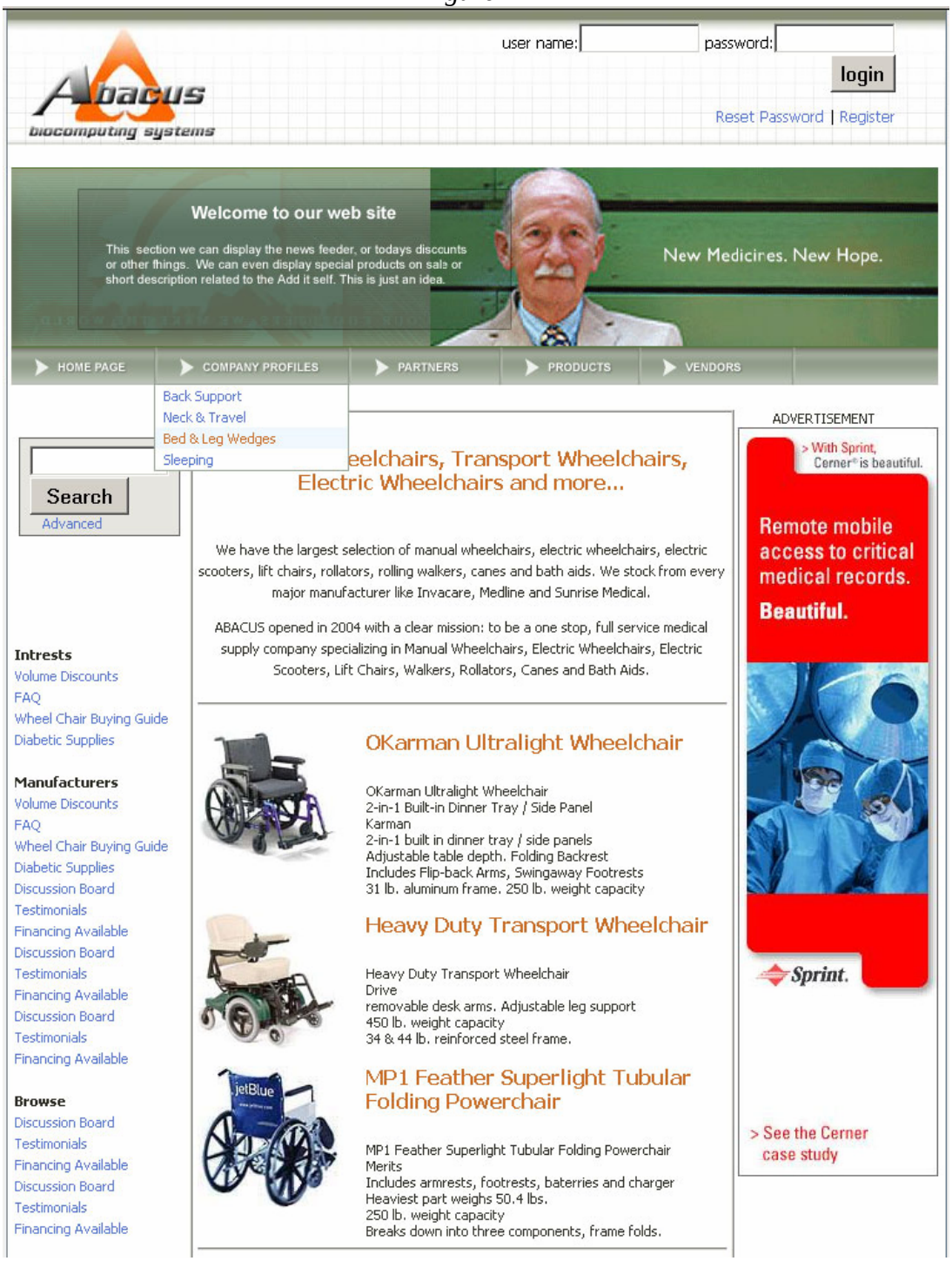


Prototype 4

Cited to be outstanding. Thought to be professional and gives the desired effect

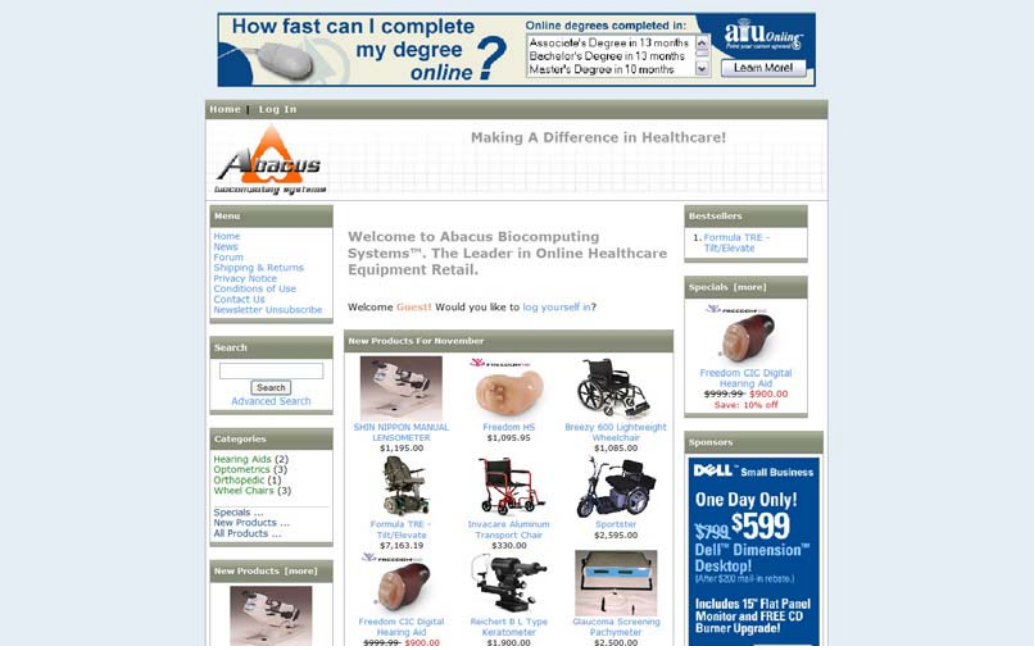
The last prototype was further developed and enhanced until it reached the stage of the current system. At this stage we took the initiative to create a logo that would best identify with the image ABS is trying to convey. We developed several prototypes and the current logo was selected as the representative mark of ABS. All further prototypes of the system contain this logo. Here are some transitional versions of our system:

Figure 17



This is the home site of an in-between system.

Figure 18



This is the News Feeder feature that we implemented in the system.

Figure 19

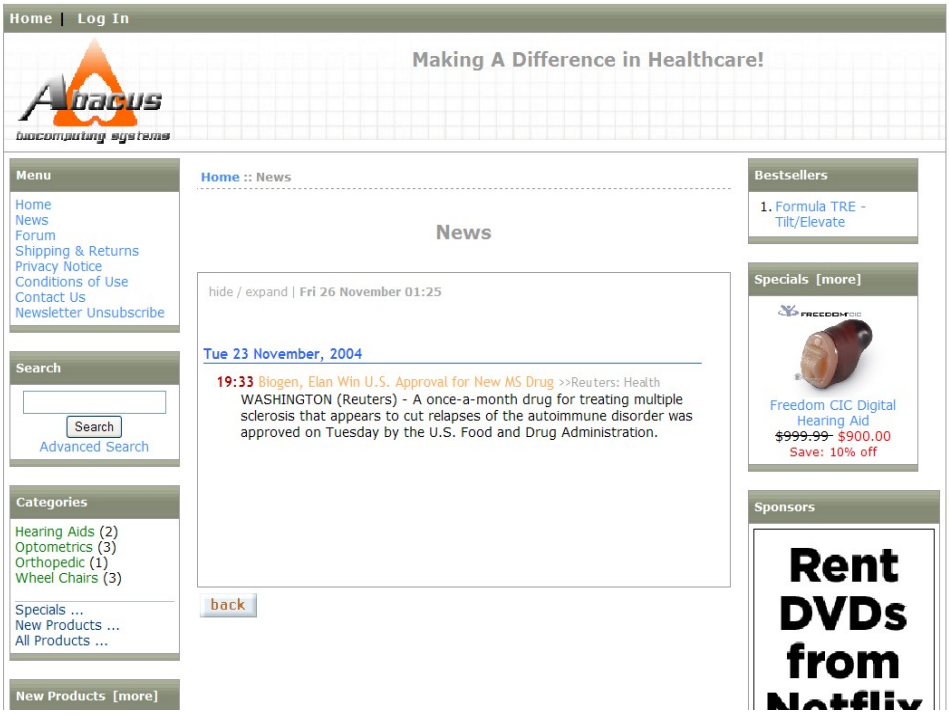
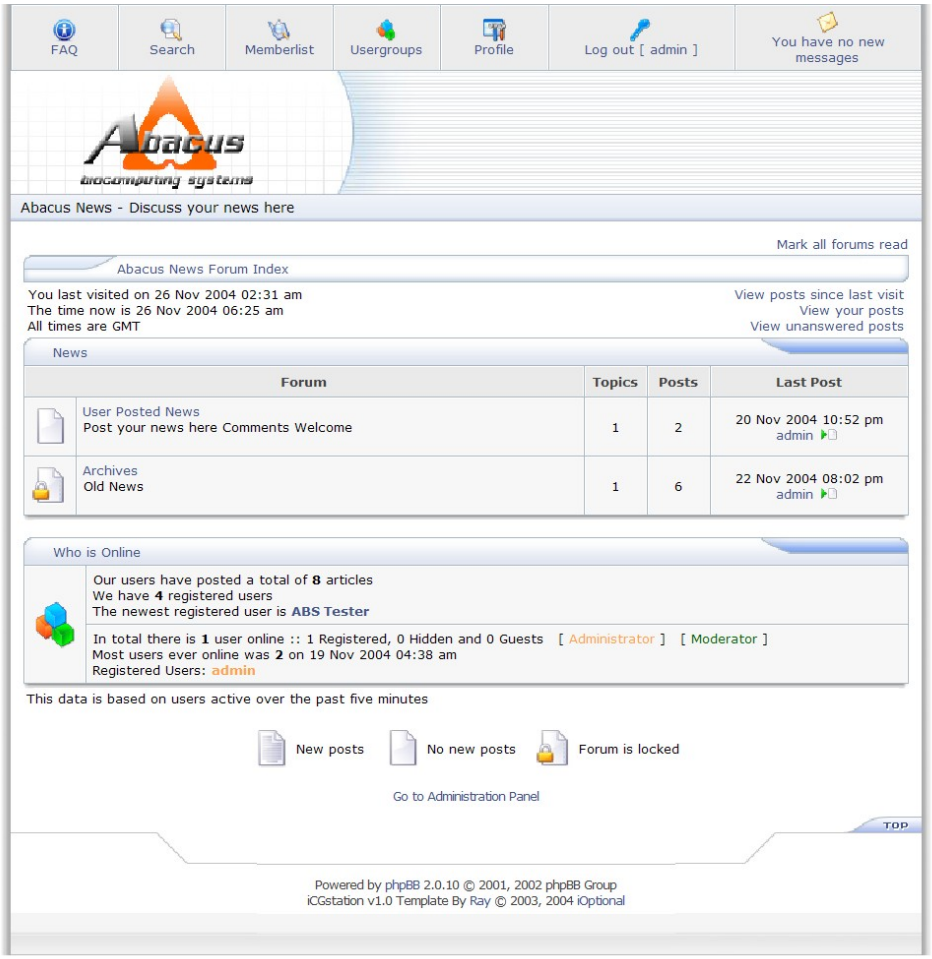


Figure 20

This is the Forum feature that we implemented in the system.



3.4 USE CASES

Actor: Patient

1. Healthcare Provider's Office: The patient visits the healthcare provider where he/she receives a diagnosis for the aliment.

Actor: Healthcare Provider

1. Healthcare Provider's Office: Produces a diagnosis for the aliment of the patient.
2. Phone System: Healthcare providers interact with the supplier through the phone system. He/She will place an order for the medical devices they need. The transaction is paid from the healthcare provider personally.
    - Will receive the bill from the supplier.
3. Insurance Company: Healthcare provider sends the bill received to their insurance company and the insurance will examine it.
    - Will receive information on what percentage of reimbursement will be provided for the devices.

Actor: Supplier

1. Phone System: Supplier will interact with the healthcare provider. An order is placed and the medical devices needed are located. The bill is mailed to the customer and the order is shipped to the office shortly after.
2. Restock with Devices: Contact the device manufacture and request for a certain amount of their devices.
    - Will receive a bill for the devices that they ordered.

Actor: Device Manufacture

1. Ship their devices to the Manufacturer.

Actor: Insurance Company

1. Reimbursement request. The insurance company will receive the list of medical devices that the healthcare provider purchased.
    - Fully reimbursement granted.
    - Non or partial reimbursement granted.

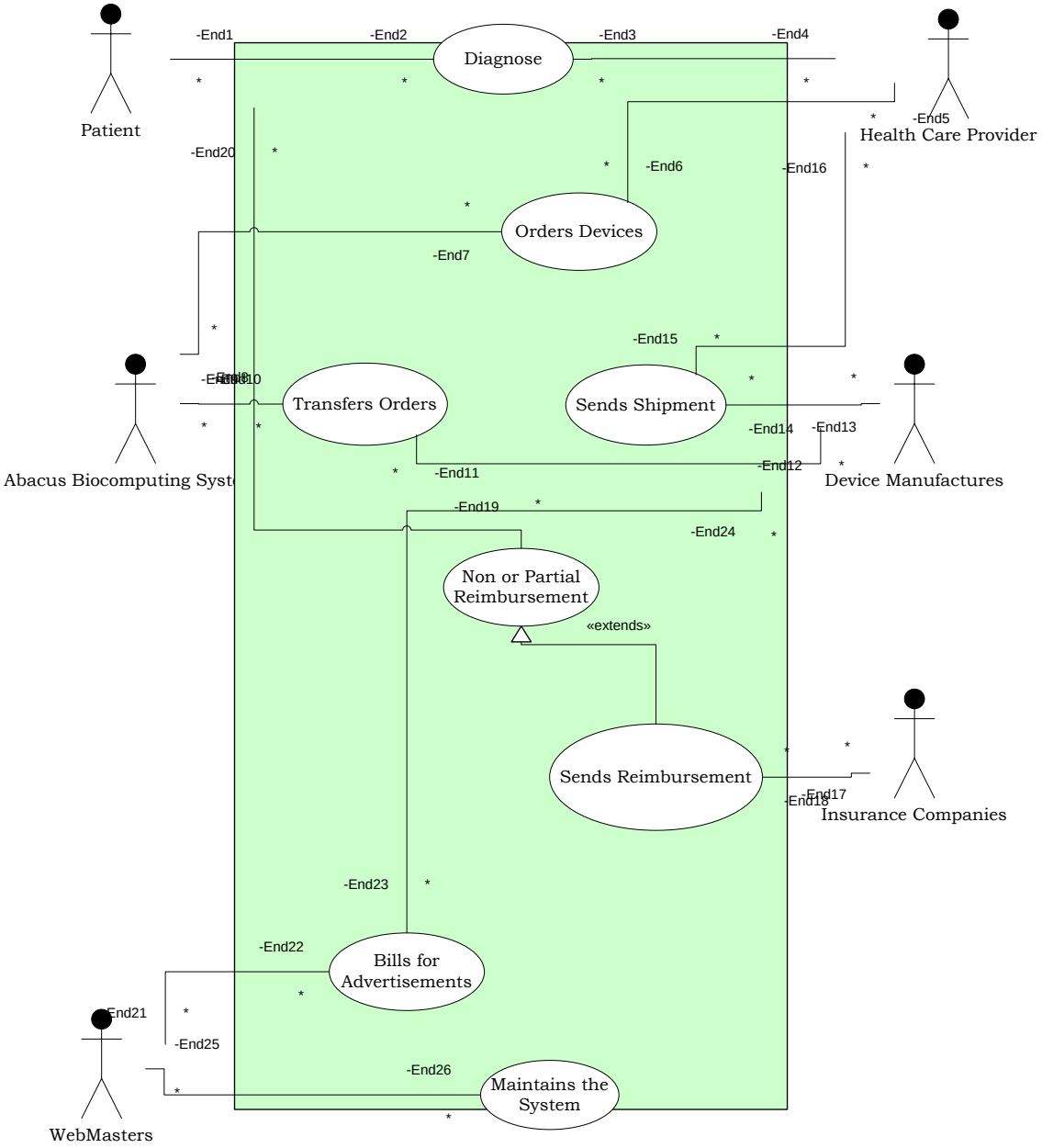
3.4.1 Use Case Diagrams

3.4.1.1 AS-IS System

Figure 21

3.4.1.2 TO-BE System

Figure 22



3.5 REQUIREMENTS WRITING

3.5.1 Functional Requirements

To accommodate the e-commerce needs of Abacus Biocomputing Systems, a modular system must be developed in adherence to the following requirements.

1. The system must comprise of a template with plug and play capabilities for the e-commerce components.
2. The system must have areas for public users, registered users and administrative users and provide an authentication method for each, respectively.
3. The system must provide a list of all products available for purchase along with the relevant information attributed to each of them.
4. The system must possess a shopping cart facility with ability to perform automated transactions.
5. The system must display advertisements to generate revenue and must use a feature that manages those advertisements.
6. The system must record statistics for advertisements displayed and generate reports for these statistics.
7. The system must have a newsreader and display updated health related news from RSS feeds.
8. The system must provide capability for the registered users to post their own news content and allow other users to comment on it.
9. The system must be able to syndicate user posted news as RSS feeds.
10. The system must find a balance for the commercial purposes as well as to develop a community feeling among its users.

11. The system must provide adequate security for sensitive data pertaining to the users.
12. The system must provide the administrator(s) a utility to manage content pertaining to products, news, ads, etc., using a Graphical User Interface (GUI).
13. The system must be aesthetically stimulating and easy to use.
14. The system must provide adequate notifications for all transactions and generate relevant reports.
15. The system must be scalable, easily maintainable, reusable and reliable.

3.5.2 Non-Functional Requirements

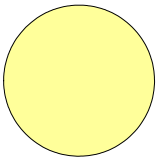
1. The system must only utilize open source technologies for its development.
2. The system must use PHP programming language.
3. The system must use MySQL for its Back-End database needs.
4. The system must use JavaScript for data validation.
5. The system must run on an Apache web server.
6. The system must be operable on all platforms and should be accessible through any web browser.
7. The system must adhere to the W3C (World Wide Web Consortium) standards and developed in XHTML 1.0 Transitional.
8. The application must be viewable on any machine with an internet connection and the following minimum system requirements:

    Intel Pentium 200 MHz
    32 MB RAM
    10 MB Free Hard Drive Space
    Windows, Macintosh, UNIX or Linux OS
    Web browsers equivalent to: IE 4.0 or Netscape 4.0

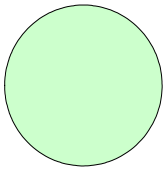
3.6 MODELING REQUIREMENTS

3.6.1 Data Flow Diagrams

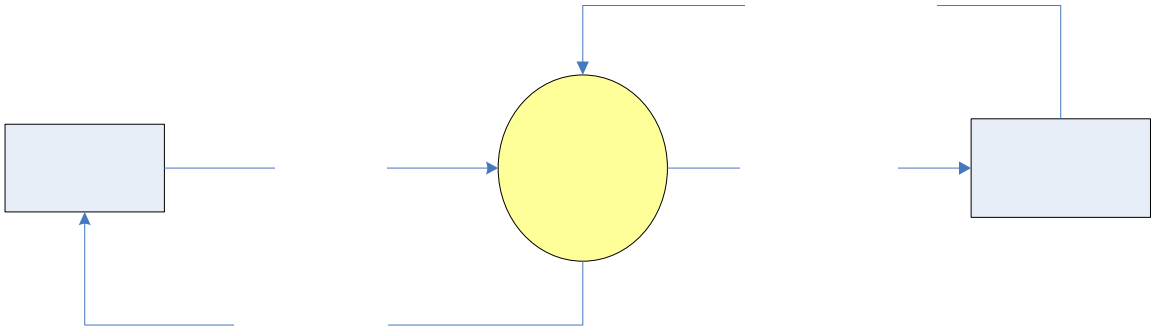
Symbol Representation

AS-IS System Process 

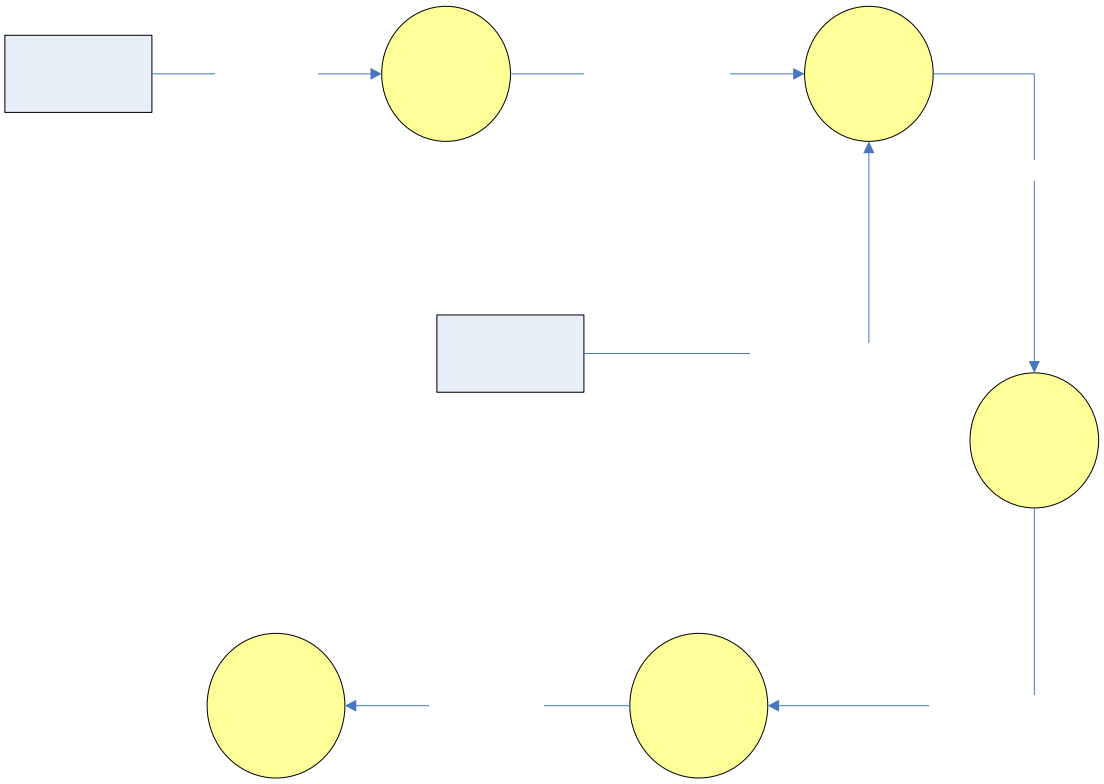
External Entity 

TO-BE System Process 

3.6.1.1 Context Diagram: AS-IS System



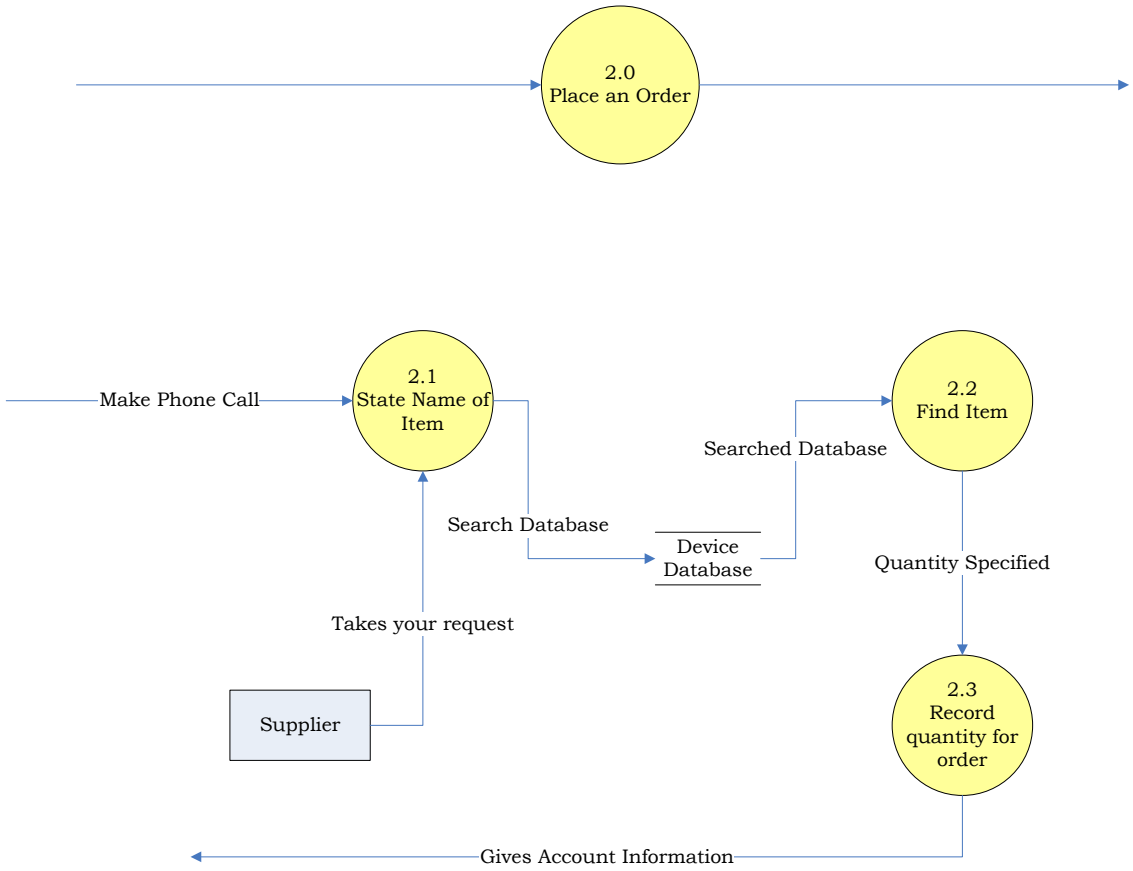
3.6.1.2 General Diagram: AS-IS System



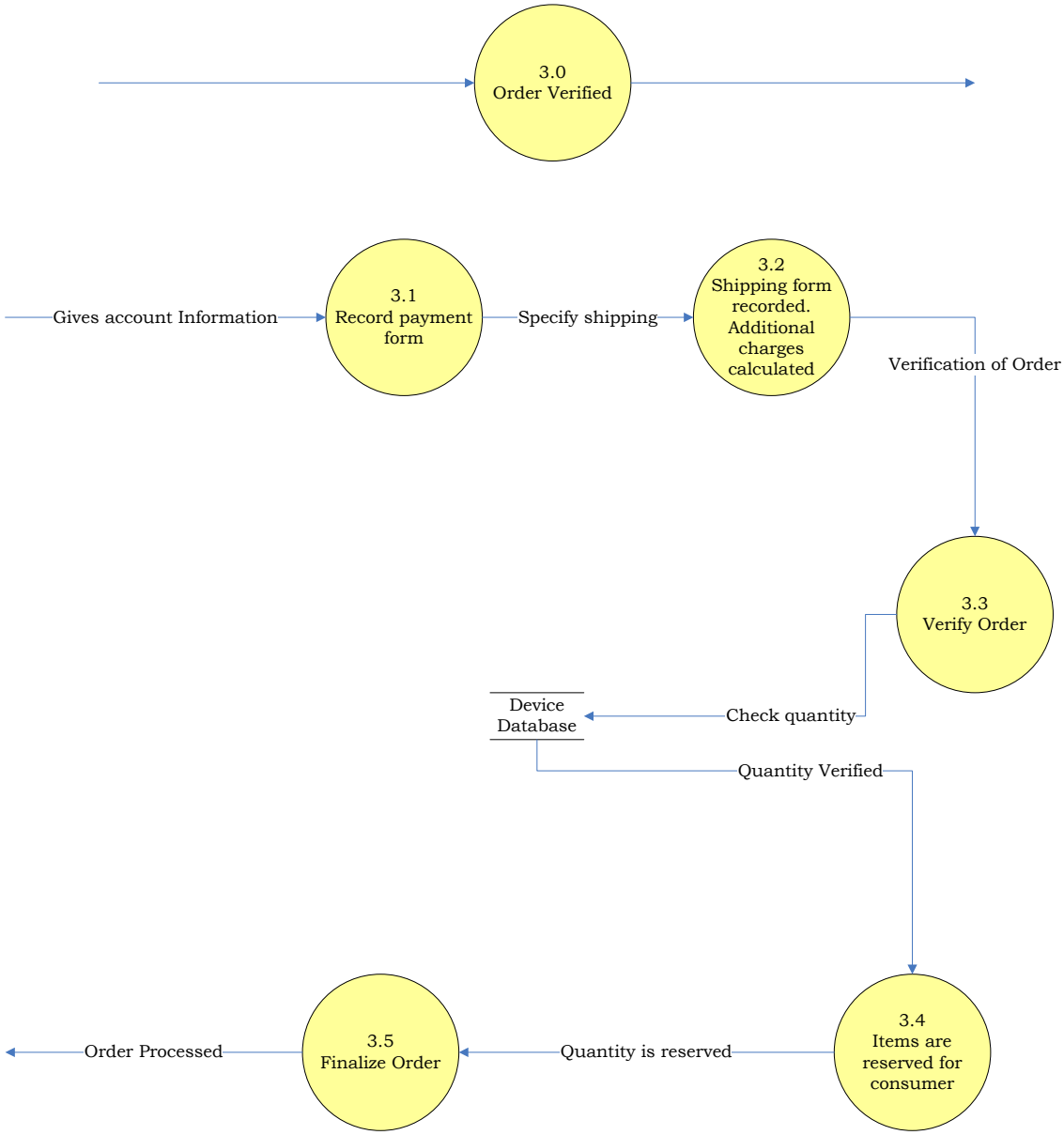
Health Care Provider

Makes Order

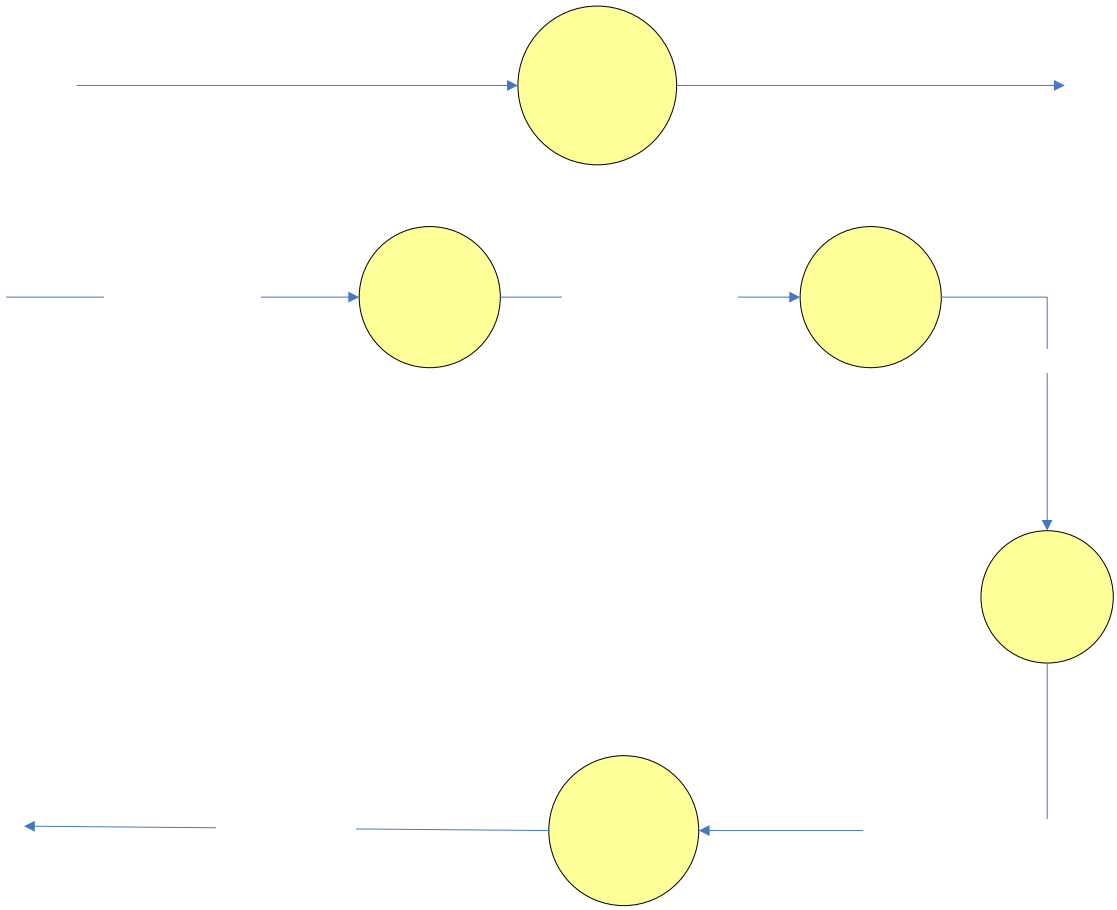
3.6.1.3 Decomposition of 2.0: AS-IS System



3.6.1.4 Decomposition of 3.0: AS-IS System



3.6.1.5 Decomposition of 4.0: AS-IS System



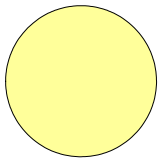
Design

4. DESIGN

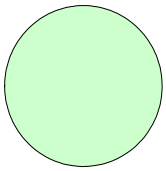
4.1 MODULAR DECOMPOSITION

4.1.1 Data Flow Diagrams

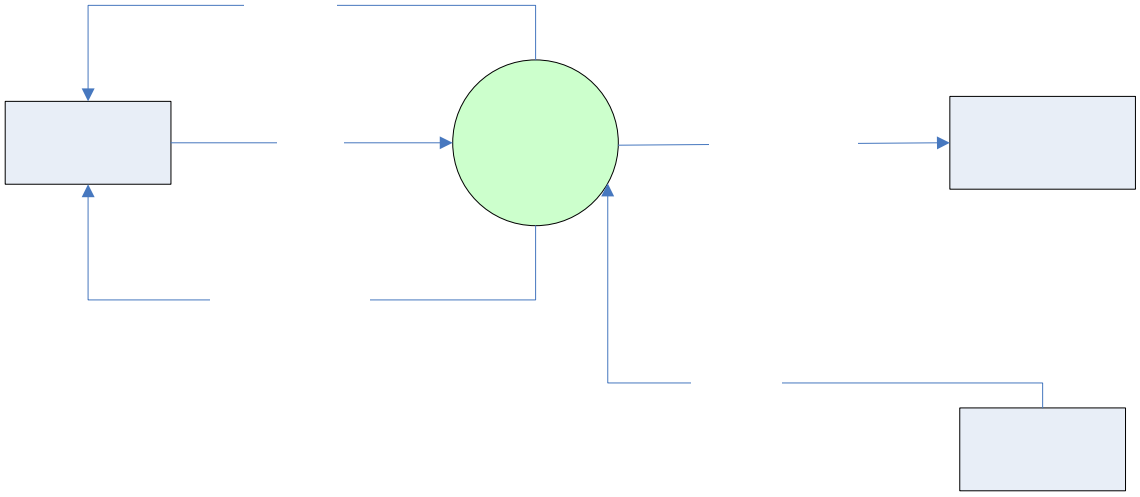
Symbol Representation

AS-IS System Process 

External Entity 

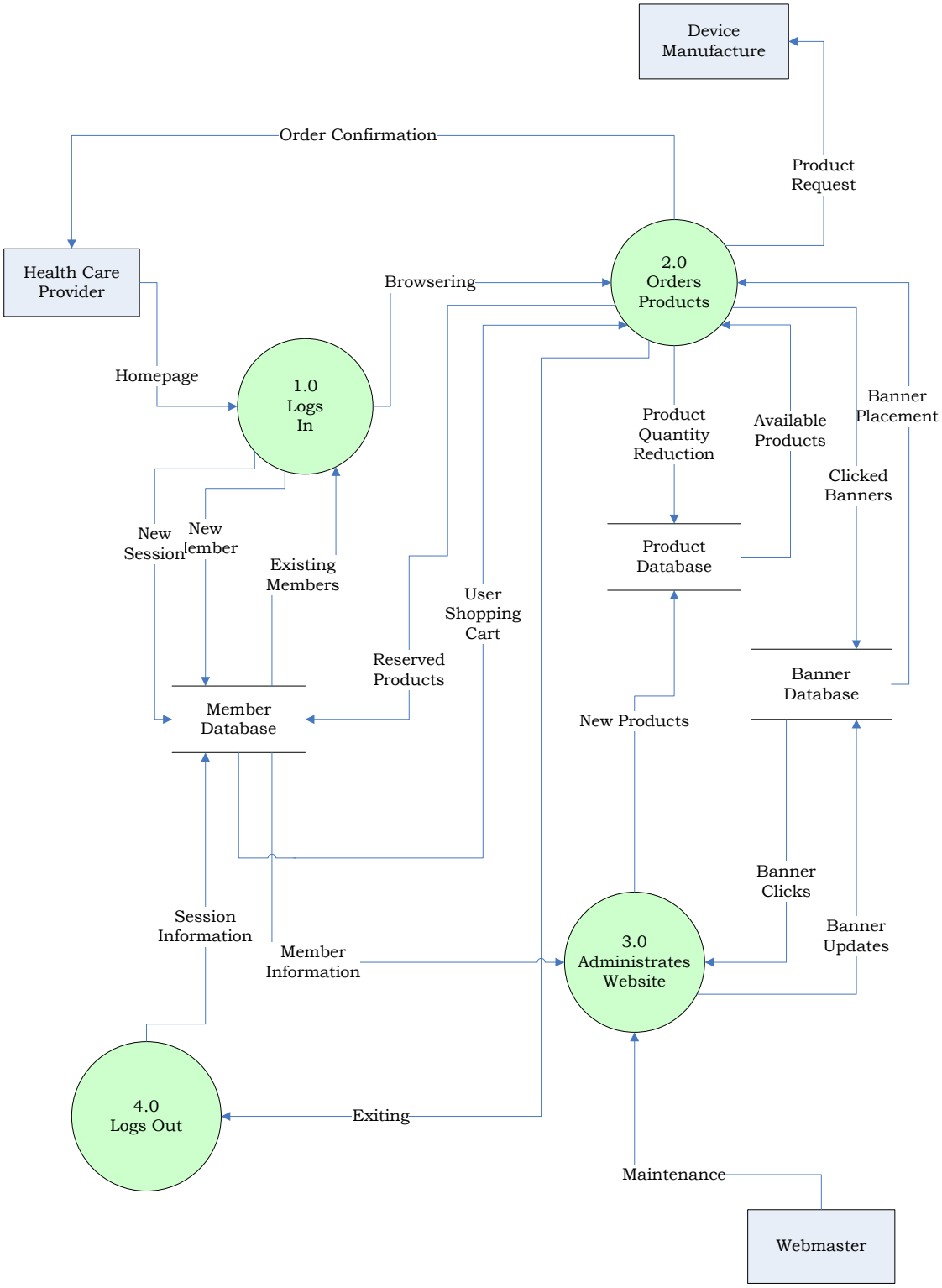
TO-BE System Process 

4.1.1.1 Context Diagram: To–Be System

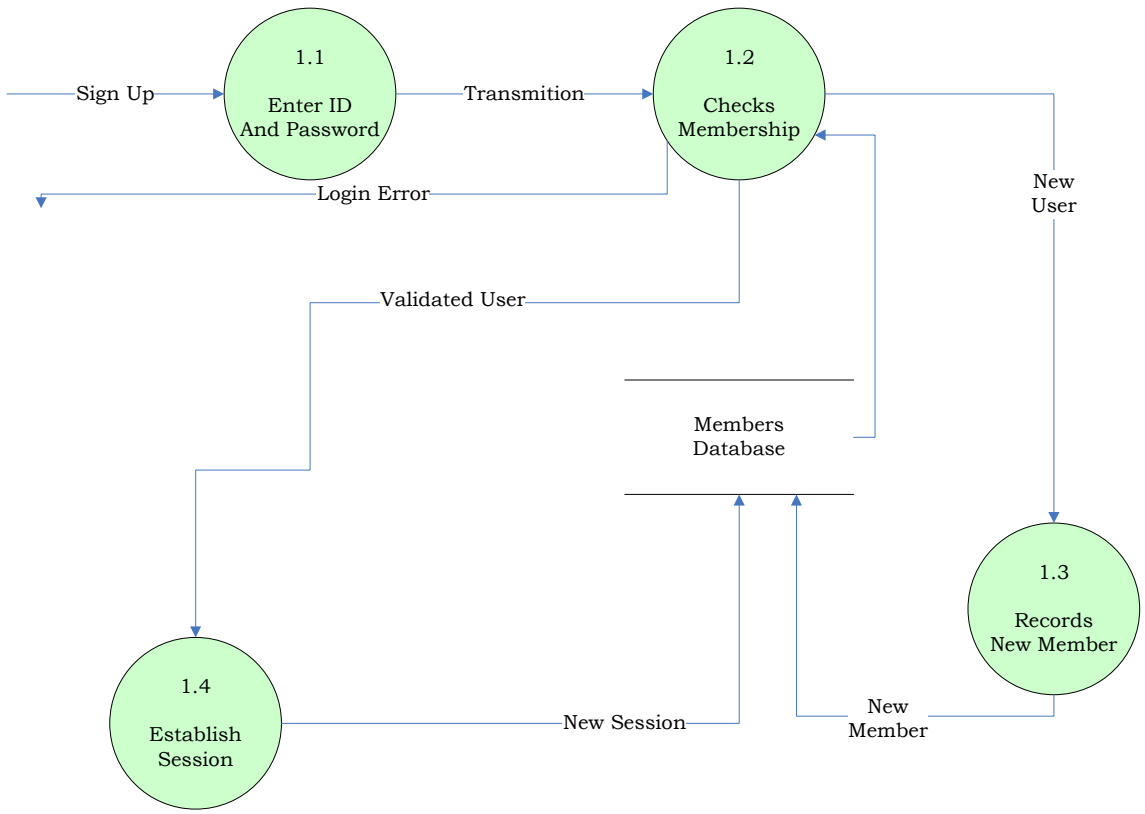


Login Error

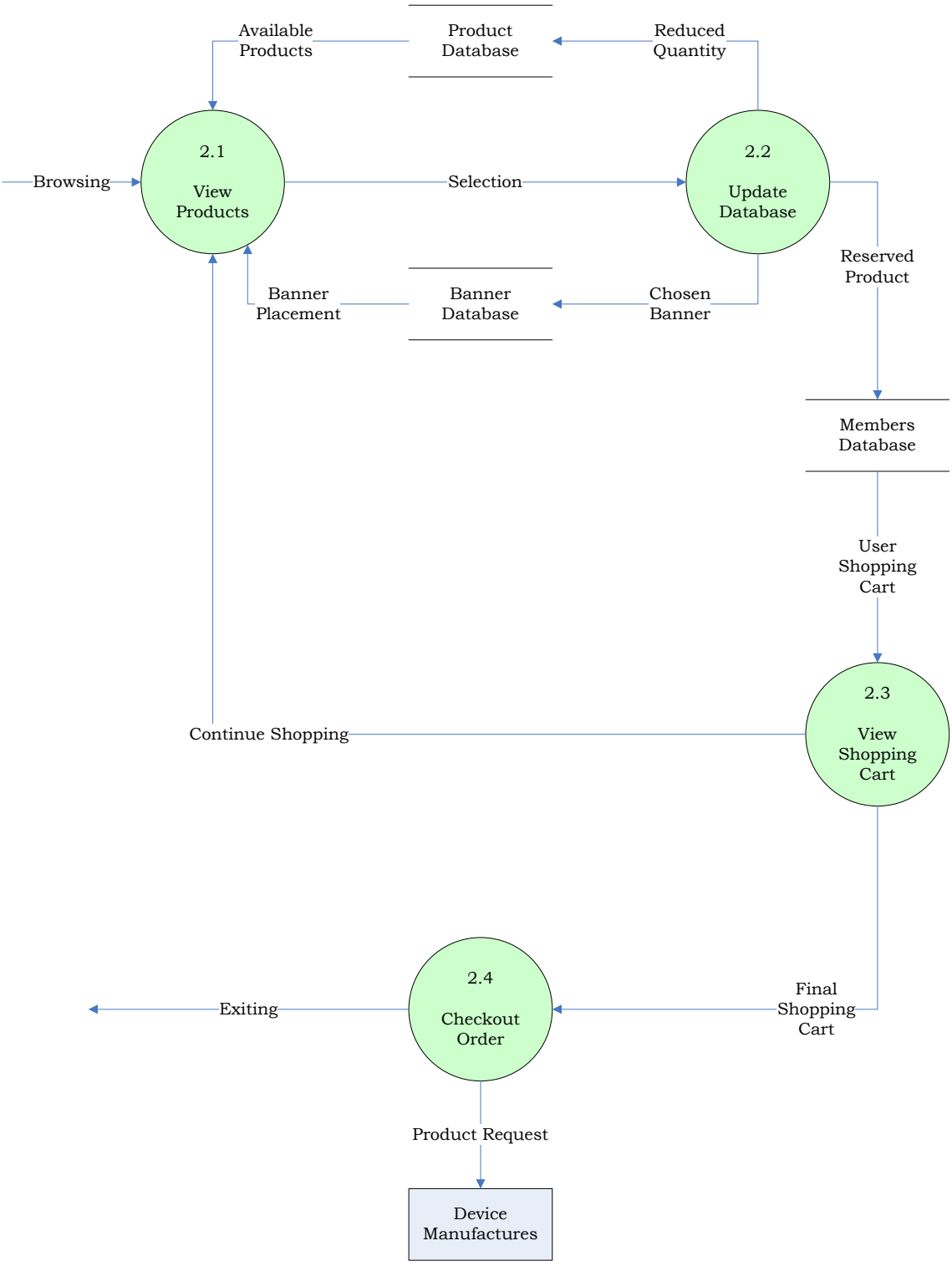
4.1.1.2 General Diagram: To–Be System



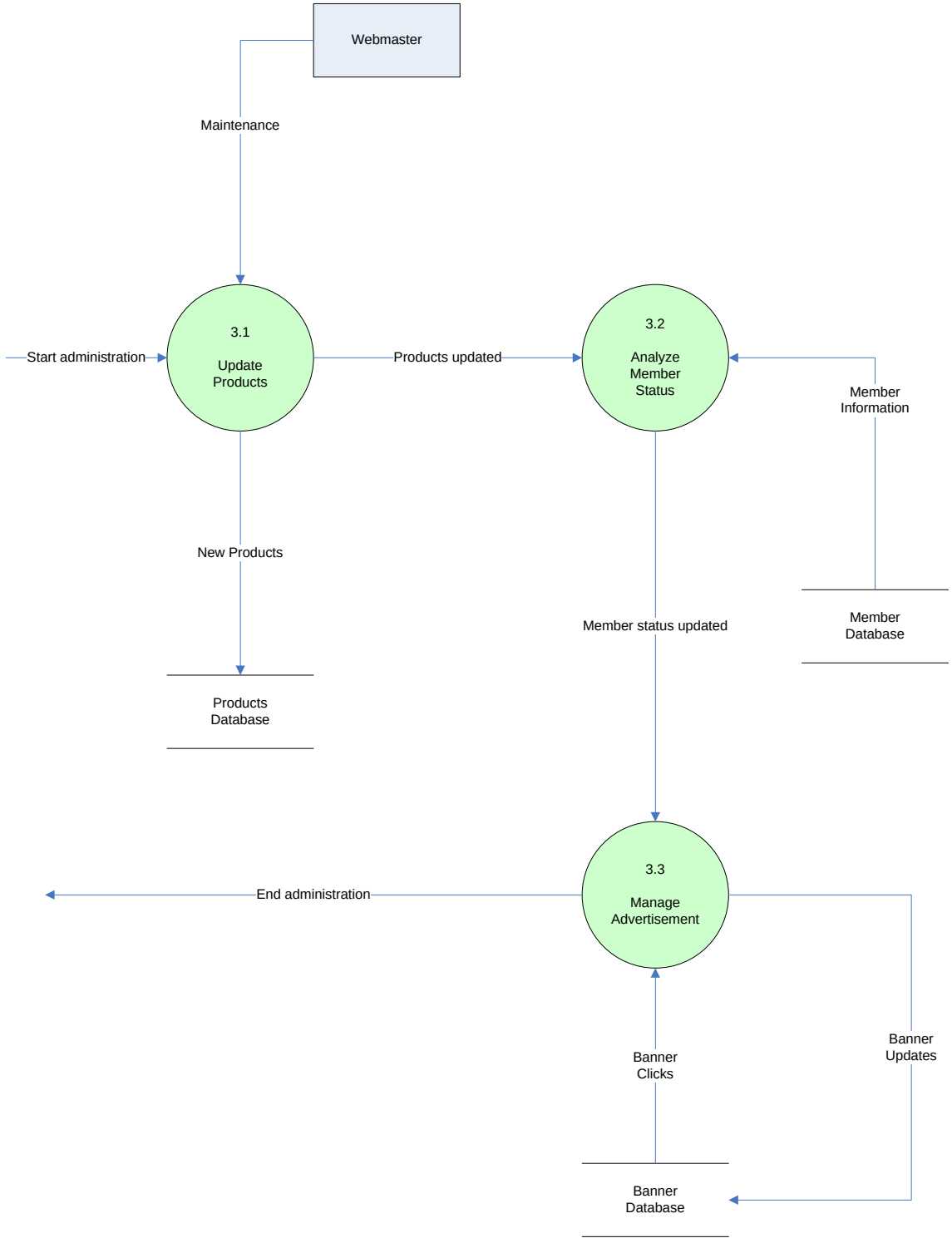
4.1.1.3 Decomposition 1.0: To–Be System



4.1.1.4 Decomposition 2.0: To–Be System



4.1.1.5 Decomposition 3.0: To–Be System



4.1.2 Data Dictionary

User-Name	Name+User-ID+Password+Address+Phone-Number+Card-Number
Name	Fname+Lname
Fname	{[A|B|C…|a|b|c|…]}
Lname	{[A|B|C…|a|b|c|…]}
Address	Building-Number+Street+City+Zip-Code
Phone-Number	{[0|1|2|…|-|]}
Area-Code	{[0|1|2|…]}
Building-Number	{[0|1|2|…|A|B|C…|a|b|c|…]}
Street	{[A|B|C…|a|b|c|…|0|1|2|...]}
City	{[A|B|C…|a|b|c|…]}
State	{[A|B|C…|a|b|c|…]}
Zip-Code	{[0|1|2|…]}
License-Number	{[A|B|C…|a|b|c|…|0|1|2|...]}
Email-Address	{[A|B|C…|a|b|c|…|0|1|2|…|@|]}
Password	{[A|B|C…|a|b|c|…|0|1|2|...]}
Product	Product-ID+Product-Name+Price
Product-ID	{[A|B|C…|a|b|c|…|0|1|2|...]}
Product-Name	{[A|B|C…|a|b|c|…]}
Manufacturer-Name	{[A|B|C…|a|b|c|…]}
Review	{[A|B|C…|a|b|c|…]}
Category	{[A|B|C…|a|b|c|…]}
Date	{[0|1|2|…|/|-|]}
Price	{[0|1|2|…]}
Quantity	{[0|1|2|…]}
Shopping-Cart	Product-ID+Product-Name+User ID+Hcode+Quantity
User-ID	{[0|1|2|…|A|B|C…|a|b|c|…]}
DOB	{[0|1|2|…|/|-|]}
Credit-Card-Number	{[0|1|2|…|-|]}

Table 9

4.1.3 Process Specifications

4.1.3.1 Structured English

Process 1.0 Registering for Abacus Biocomputing Systems

ENTER USER-DATA

VERIFY USER-DATA
IF
USER-DATA = valid and if DUPLICATION = No
Output “Your Account Has Been Created!”
ELSE
Send Message: “You entered and incorrect username and password.”

Click on “SUBMITT” Button at the bottom of the page

Process 2.0 Purchase Product

ENTER EMAIL and Password

VERIFY EMAIL and Password with respect to database

IF
EMAIL and Password matches’ record in database
THEN
Allow registered user access to ‘Wheelchairs’
ELSE
Send Message: “You entered and incorrect username and password.”
SELECT
Category e.g. ‘Wheelchairs’
SELECT
Product of choice
REVIEW
Product information and reviews from other customers
ENTER
Quantity for number of a product

Click on “ADD TO CART" Button below quantity

REVIEW
Products and quantity in cart

Click on “CHECKOUT” Button to proceed to checkout

Click on “CONTINUE” Button to proceed to Payment Information

ENTER

Credit Card information and Special instructions

Click on "CONTINUE" Button to proceed to Order Confirmation

REVIEW

'Billing Address', 'Delivery Address', 'Special Instructions or Order Comments" and "Shopping Cart Contents"

Click on "CONFIRM" Button to confirm order

READ

Transaction approval and confirmation

Click on "CONTINUE" Button to continue shopping

Process 3.0 Read News

Click on "News" Link in the "Menu" Box

REVIEW

Read captions of News

Click on "Abacus News" Link for detailed news from source

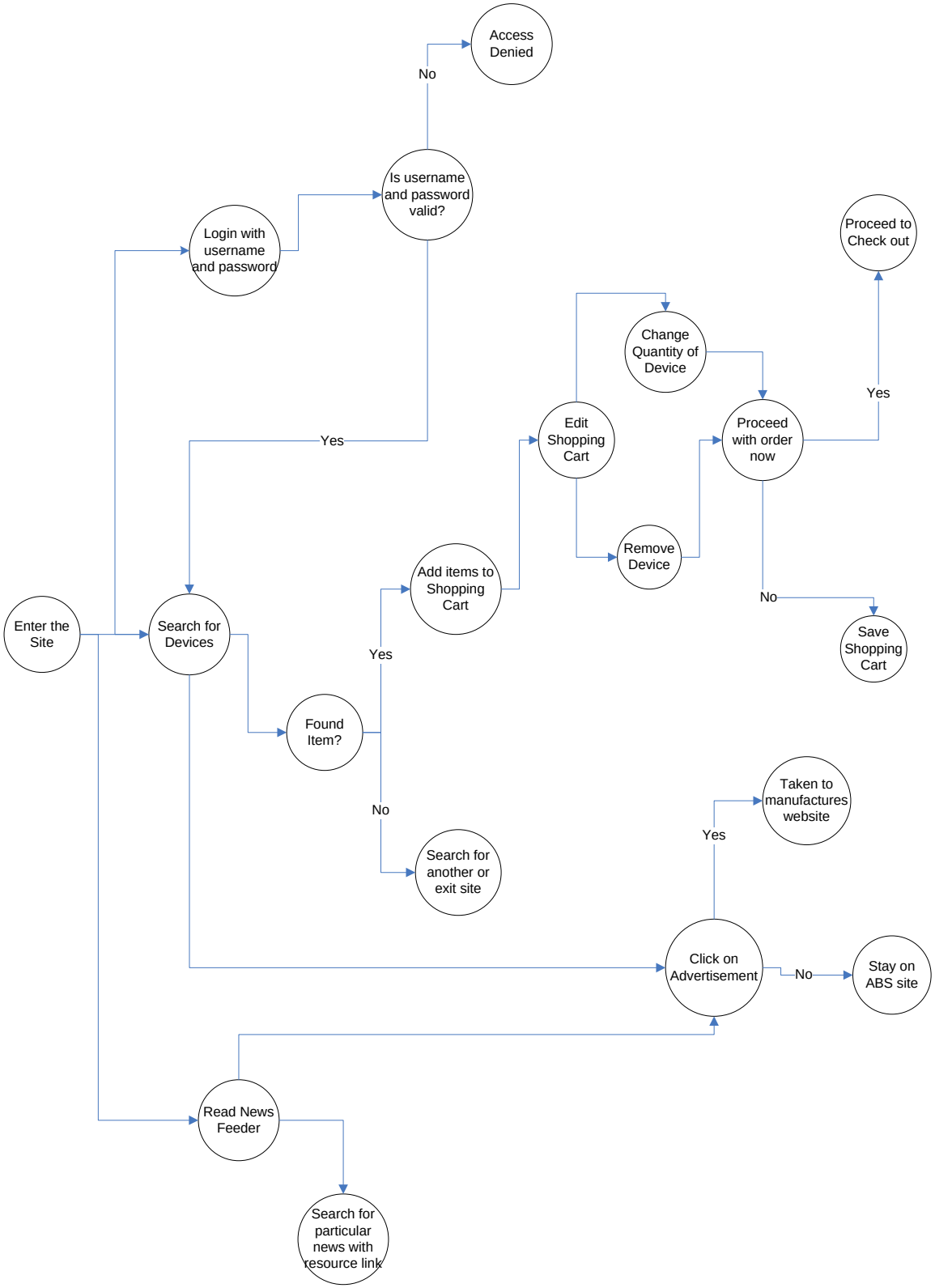
REVIEW

Read detailed news from source website

EXIT

Click on "X" in upper left hand corner to Exit new internet website window and return to Abacus Biocomputing Systems Internet window

4.1.3.2 Decision Tree



4.1.3.3 Decision Table

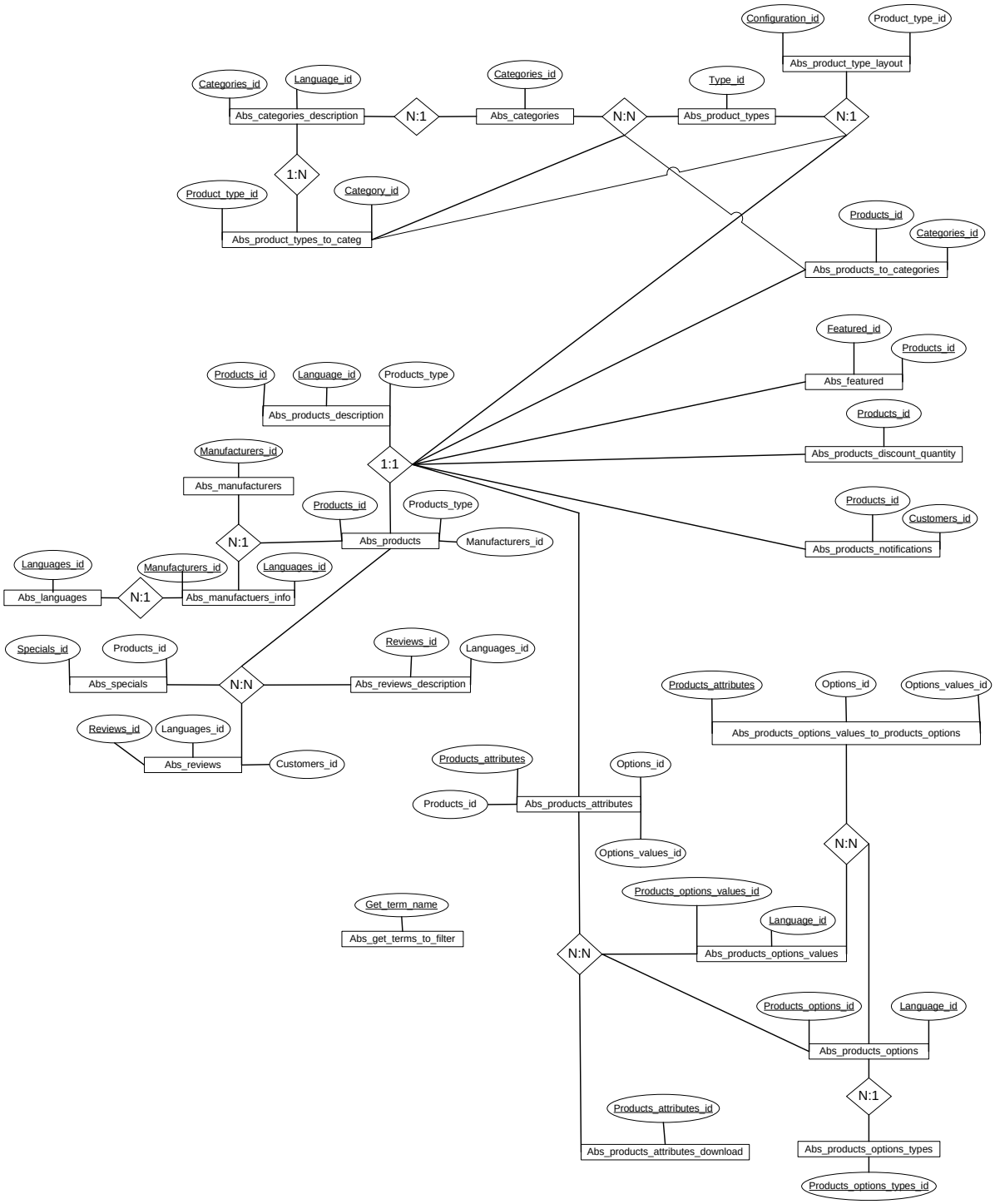
Table 10

CONDITION	RULES					
	1	2	3	4	5	6
Login	Y	Y	Y	N	N	N
Uses Search	Y	N	Y	N	Y	N
Read News	Y	Y	N	Y	N	N
ACTIONS						
Provide Access	X	X	X	-	-	-
Item Search	X	-	X	-	-	-
2nd Search	X	-	X	-	-	-
N# Search	X	-	-	-	-	-
Add to Cart	X	X	X	-	-	-
Edit Cart	X	X	X	-	-	-
Save Cart	X	X	X	-	-	-
Remove Device	X	X	X	-	-	-
Read News	X	X	-	X	-	-
Search News	X	-	X	-	-	-
Notification Alert	X	-	X	-	-	-
Purchase	X	-	-	-	-	-
Enter Review	X	-	-	-	-	-
Read Review	X	X	-	-	-	-
Exit Site	X	X	X	X	X	X

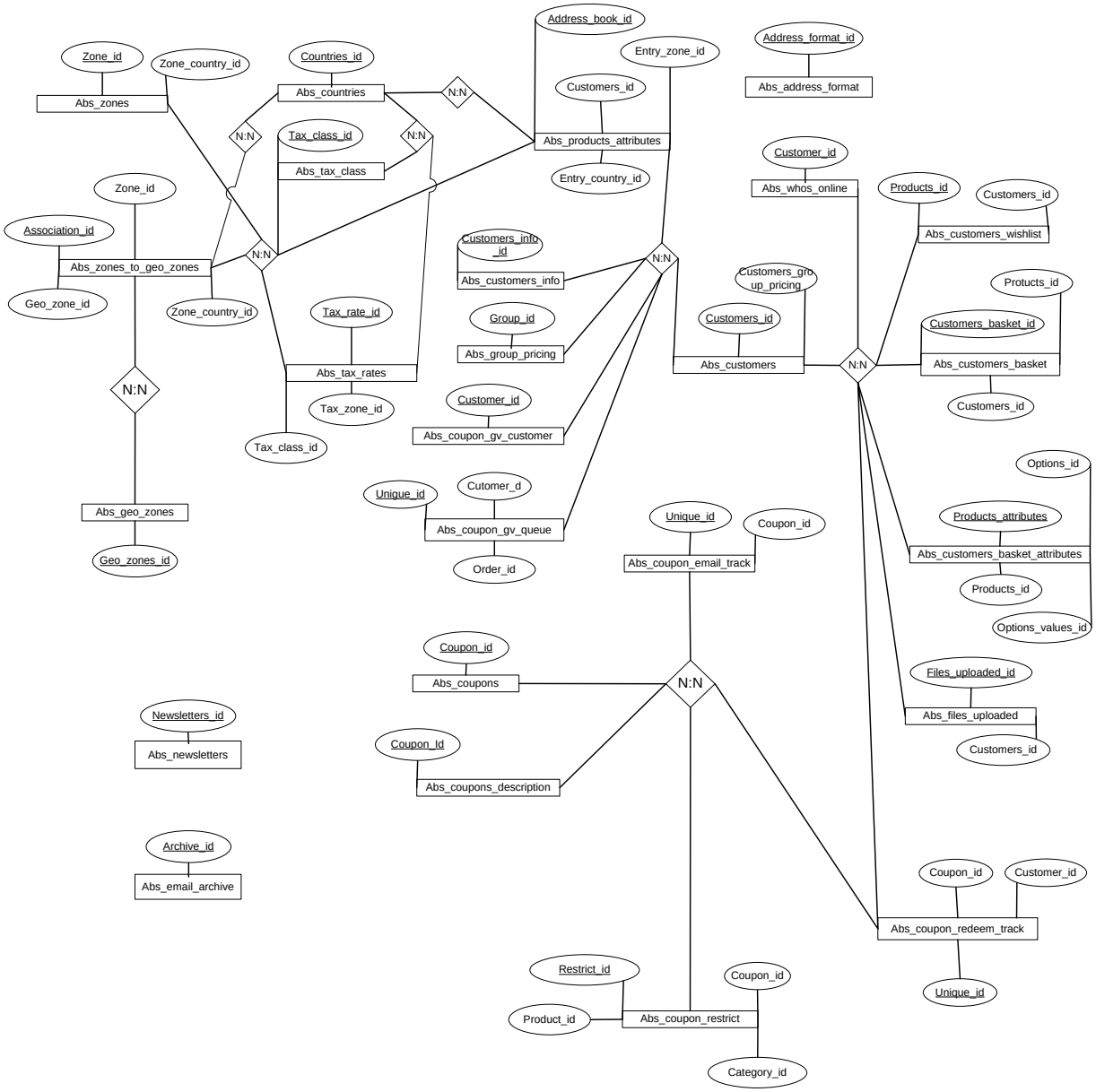
4.2 DATA DRIVEN DESIGN

4.2.1 Entity Relationship Diagram (ERD)

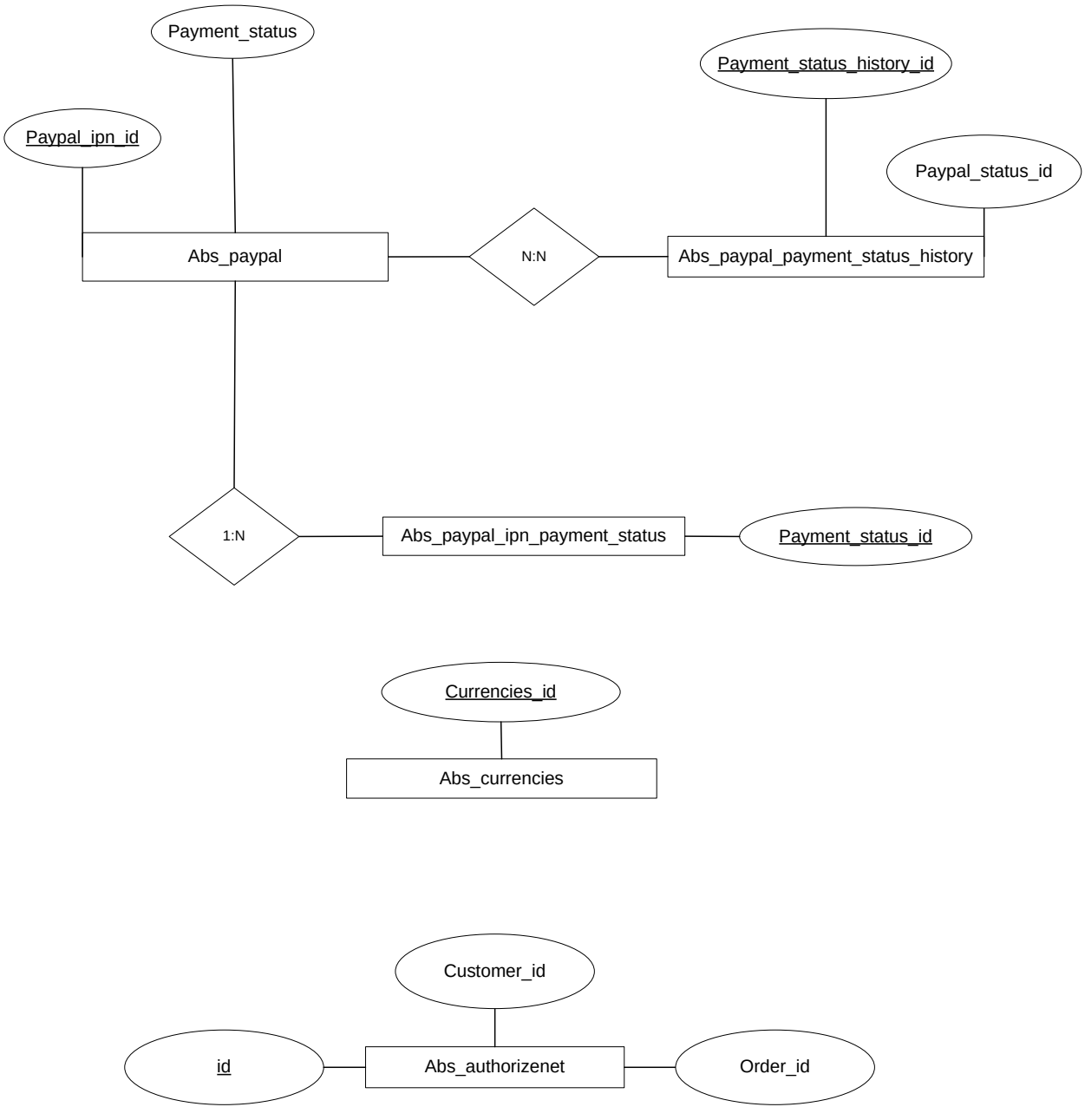
Products



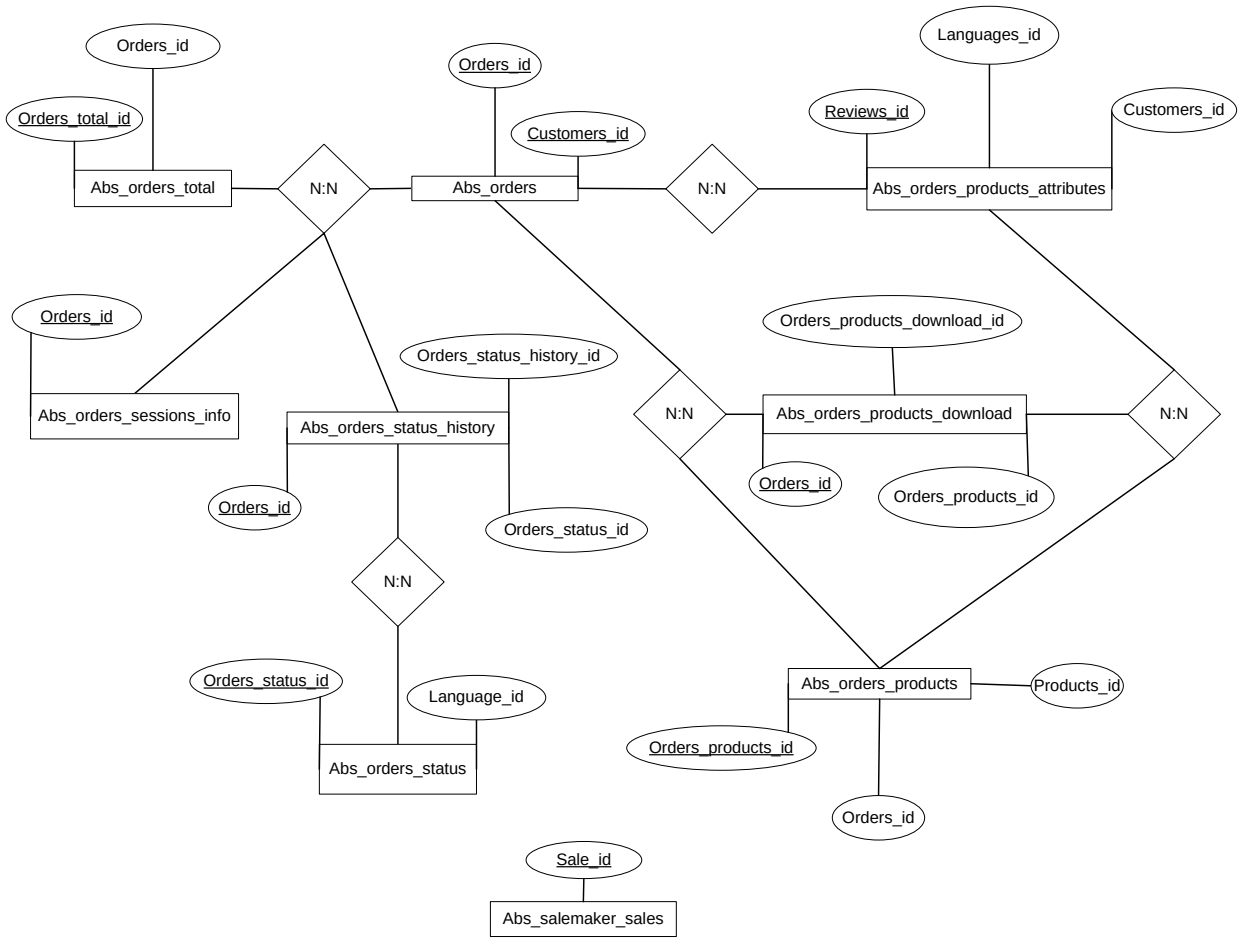
Customers


Address_book_id
Address_format_id
Zone_id
Zone_country_id
Countries_id
Entry_zone_id
Abs_address_format
Abs_zones
Abs_countries
N:N
Customers_id
Tax_class_id
Abs_products_attributes
Customer_id
Abs_tax_class
Entry_country_id
Abs_whos_online
Products_id
Customers_id
Zone_id
Association_id
Abs_customers_wishlist
Customers_info_id
Abs_zones_to_geo_zones
Customers_group_pricing
Protucts_id
Abs_customers_info
Geo_zone_id
Zone_country_id
Tax_rate_id
Group_id
Customers_id
Customers_basket_id
Abs_group_pricing
Abs_customers
Abs_customers_basket
Abs_tax_rates
Customer_id
Tax_zone_id
Abs_coupon_gv_customer
Customers_id
Tax_class_id
Options_id
Unique_id
Cutomer_d
Products_attributes
Abs_coupon_gv_queue
Unique_id
Coupon_id
Abs_customers_basket_attributes
Abs_coupon_email_track
Order_id
Products_id
Options_values_id
Abs_geo_zones
Geo_zones_id
Coupon_id
Files_uploaded_id
Abs_coupons
Abs_files_uploaded
Newsletters_id
Customers_id
Abs_newsletters
Coupon_Id
Abs_coupons_description
Archive_id
Coupon_id
Customer_id
Abs_email_archive
Abs_coupon_redeem_track
Restrict_id
Coupon_id
Unique_id
Product_id
Abs_coupon_restrict
Category_id

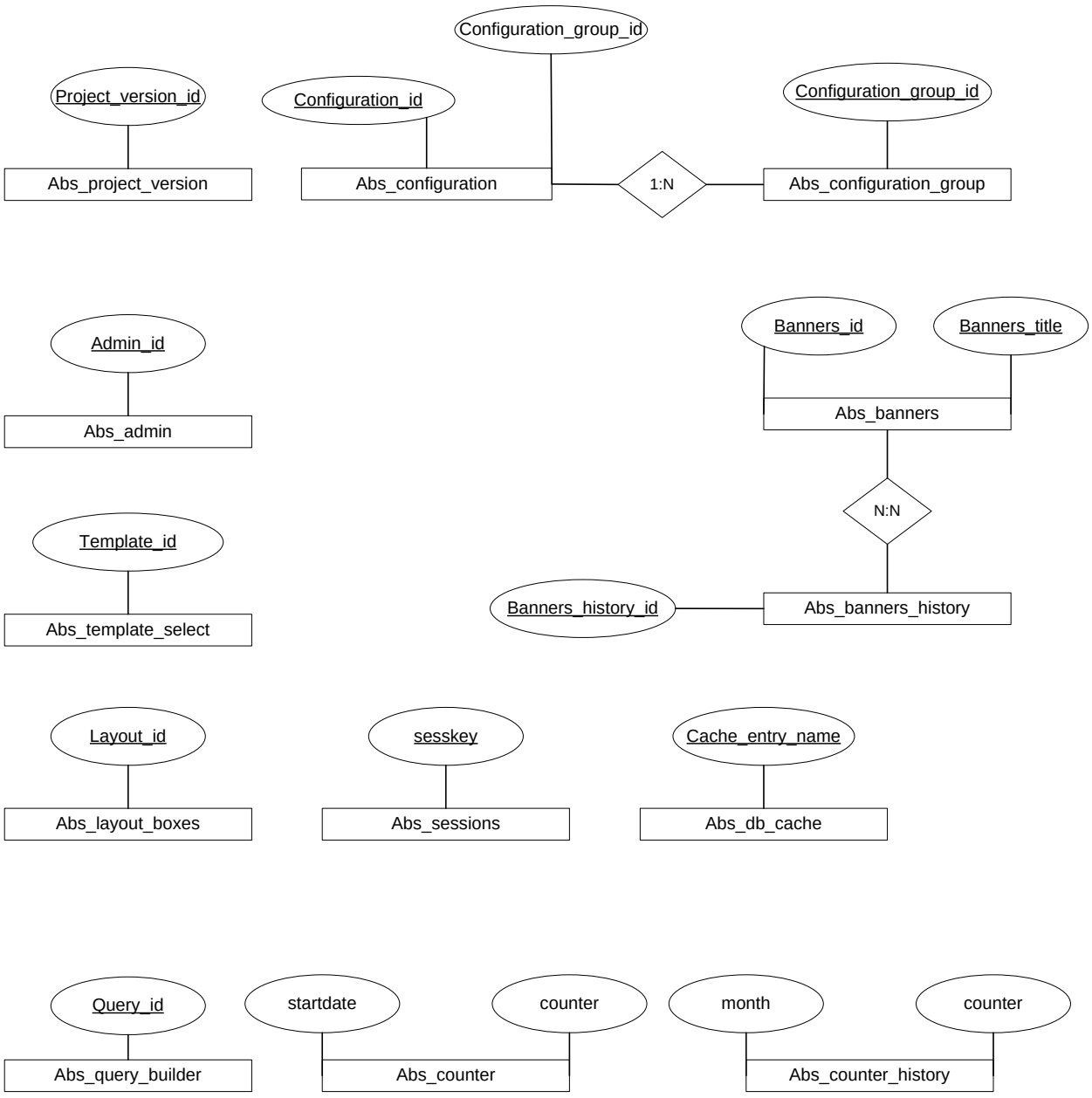
Payments


Payment_status
Payment_status_history_id
Paypal_ipn_id
Paypal_status_id
Abs_paypal
N:N
Abs_paypal_payment_status_history
1:N
Abs_paypal_ipn_payment_status
Payment_status_id
Currencies_id
Abs_currencies
Customer_id
id
Abs_authorizenet
Order_id

Orders

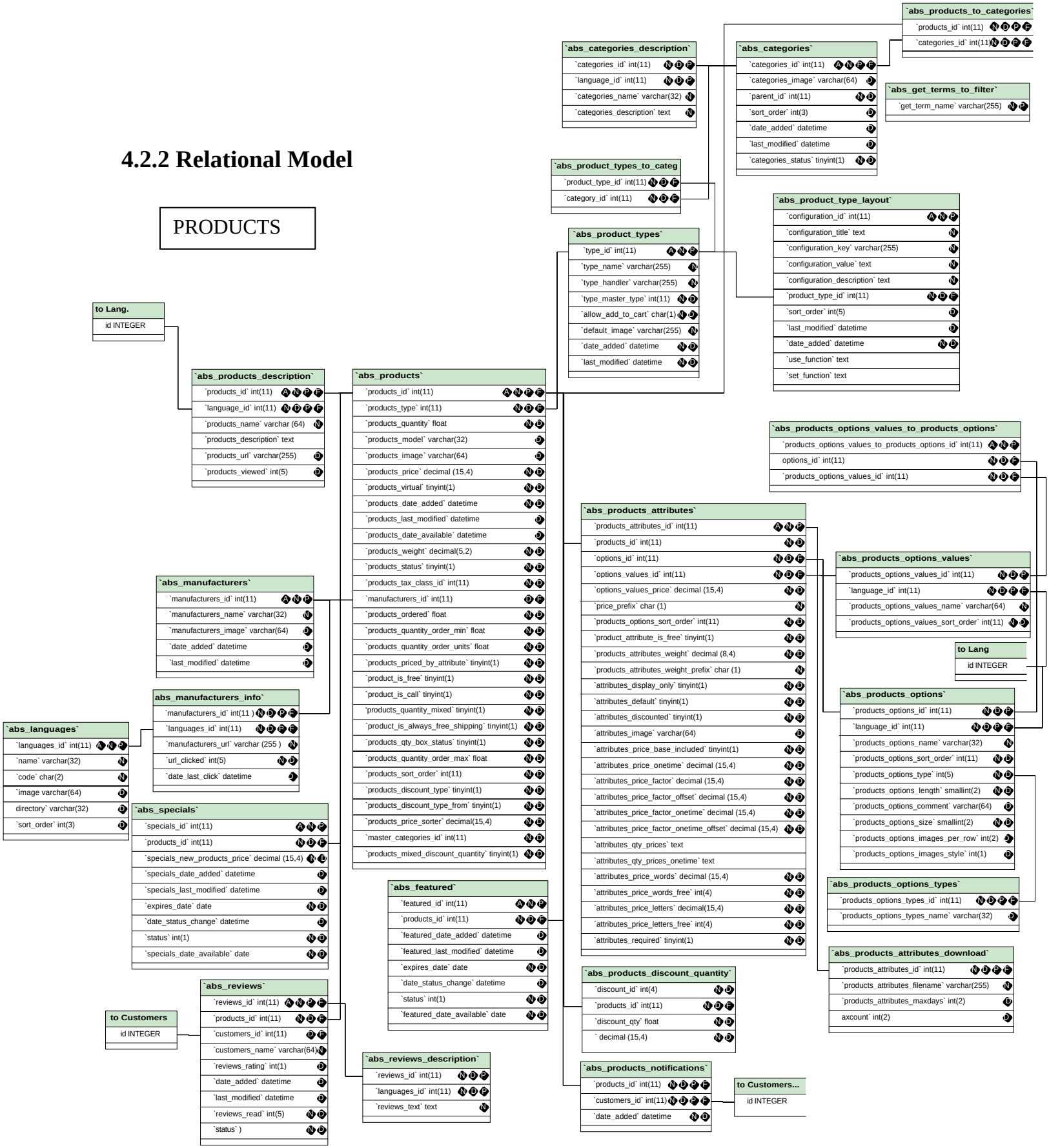

Orders_id
Orders_total_id
Abs_orders_total
N:N
Orders_id
Customers_id
Abs_orders
N:N
Languages_id
Reviews_id
Customers_id
Abs_orders_products_attributes
Orders_id
Abs_orders_sessions_info
Orders_status_history_id
Abs_orders_status_history
Orders_id
Orders_status_id
N:N
Orders_status_id
Language_id
Abs_orders_status
N:N
Orders_products_download_id
Abs_orders_products_download
Orders_id
Orders_products_id
N:N
Abs_orders_products
Products_id
Orders_products_id
Orders_id
Sale_id
Abs_salemaker_sales

Configuration

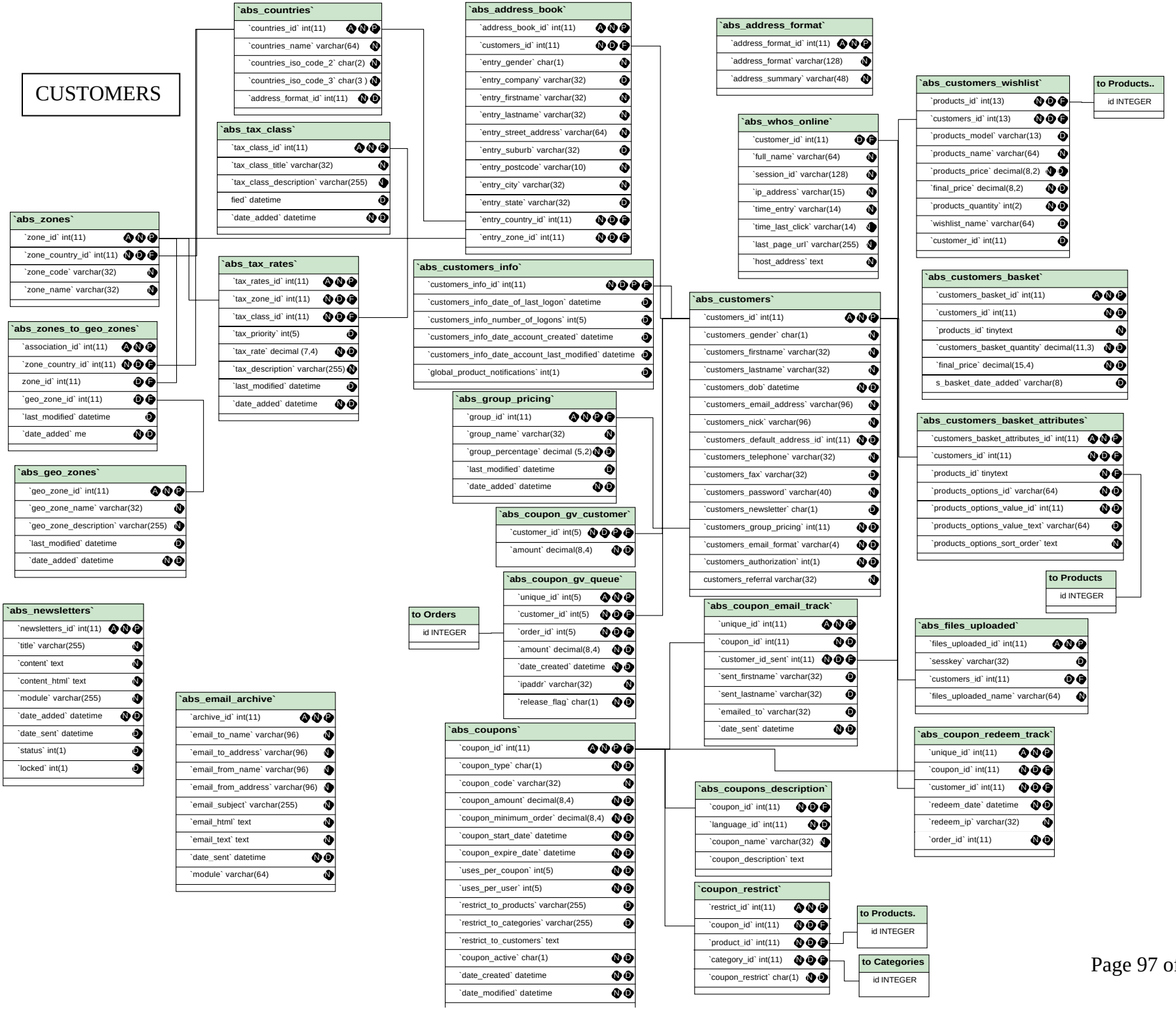


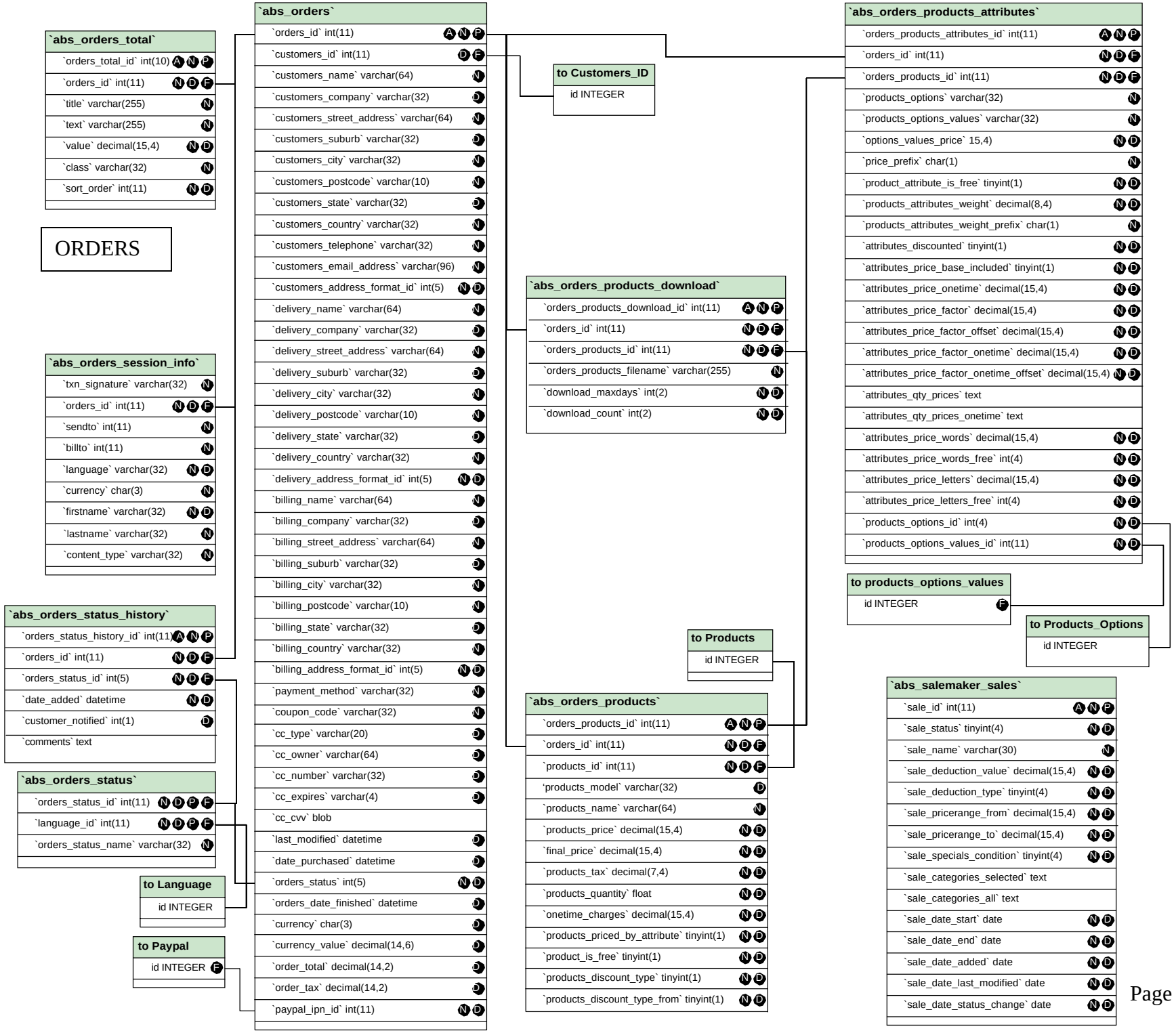
4.2.2 Relational Model

PRODUCTS



CUSTOMERS


`abs_countries`
`countries_id` int(11)
`countries_name` varchar(64)
`countries_iso_code_2` char(2)
`countries_iso_code_3` char(3)
`address_format_id` int(11)
`abs_address_book`
`address_book_id` int(11)
`customers_id` int(11)
`entry_gender` char(1)
`entry_company` varchar(32)
`entry_firstname` varchar(32)
`entry_lastname` varchar(32)
`entry_street_address` varchar(64)
`entry_suburb` varchar(32)
`entry_postcode` varchar(10)
`entry_city` varchar(32)
`entry_state` varchar(32)
`entry_country_id` int(11)
`entry_zone_id` int(11)
`abs_address_format`
`address_format_id` int(11)
`address_format` varchar(128)
`address_summary` varchar(48)
`abs_customers_wishlist`
`products_id` int(13)
`customers_id` int(13)
`products_model` varchar(13)
`products_name` varchar(64)
`products_price` decimal(8,2)
`final_price` decimal(8,2)
`products_quantity` int(2)
`wishlist_name` varchar(64)
`customer_id` int(11)
to Products..
id INTEGER
`abs_tax_class`
`tax_class_id` int(11)
`tax_class_title` varchar(32)
`tax_class_description` varchar(255)
fied` datetime
`date_added` datetime
`abs_whos_online`
`customer_id` int(11)
`full_name` varchar(64)
`session_id` varchar(128)
`ip_address` varchar(15)
`time_entry` varchar(14)
`time_last_click` varchar(14)
`last_page_url` varchar(255)
`host_address` text
`abs_zones`
`zone_id` int(11)
`zone_country_id` int(11)
`zone_code` varchar(32)
`zone_name` varchar(32)
`abs_tax_rates`
`tax_rates_id` int(11)
`tax_zone_id` int(11)
`tax_class_id` int(11)
`tax_priority` int(5)
`tax_rate` decimal (7,4)
`tax_description` varchar(255)
`last_modified` datetime
`date_added` datetime
`abs_customers_info`
`customers_info_id` int(11)
`customers_info_date_of_last_logon` datetime
`customers_info_number_of_logons` int(5)
`customers_info_date_account_created` datetime
`customers_info_date_account_last_modified` datetime
`global_product_notifications` int(1)
`abs_customers_basket`
`customers_basket_id` int(11)
`customers_id` int(11)
`products_id` tinytext
`customers_basket_quantity` decimal(11,3)
`final_price` decimal(15,4)
s_basket_date_added` varchar(8)
`abs_zones_to_geo_zones`
`association_id` int(11)
`zone_country_id` int(11)
zone_id` int(11)
`geo_zone_id` int(11)
`last_modified` datetime
`date_added` me
`abs_group_pricing`
`group_id` int(11)
`group_name` varchar(32)
`group_percentage` decimal (5,2)
`last_modified` datetime
`date_added` datetime
`abs_customers`
`customers_id` int(11)
`customers_gender` char(1)
`customers_firstname` varchar(32)
`customers_lastname` varchar(32)
`customers_dob` datetime
`customers_email_address` varchar(96)
`customers_nick` varchar(96)
`customers_default_address_id` int(11)
`customers_telephone` varchar(32)
`customers_fax` varchar(32)
`customers_password` varchar(40)
`customers_newsletter` char(1)
`customers_group_pricing` int(11)
`customers_email_format` varchar(4)
`customers_authorization` int(1)
customers_referral varchar(32)
`abs_customers_basket_attributes`
`customers_basket_attributes_id` int(11)
`customers_id` int(11)
`products_id` tinytext
`products_options_id` varchar(64)
`products_options_value_id` int(11)
`products_options_value_text` varchar(64)
`products_options_sort_order` text
`abs_geo_zones`
`geo_zone_id` int(11)
`geo_zone_name` varchar(32)
`geo_zone_description` varchar(255)
`last_modified` datetime
`date_added` datetime
`abs_coupon_gv_customer`
`customer_id` int(5)
`amount` decimal(8,4)
to Products
id INTEGER
`abs_coupon_gv_queue`
`unique_id` int(5)
`customer_id` int(5)
`order_id` int(5)
`amount` decimal(8,4)
`date_created` datetime
`ipaddr` varchar(32)
`release_flag` char(1)
to Orders
id INTEGER
`abs_coupon_email_track`
`unique_id` int(11)
`coupon_id` int(11)
`customer_id_sent` int(11)
`sent_firstname` varchar(32)
`sent_lastname` varchar(32)
`emailed_to` varchar(32)
`date_sent` datetime
`abs_files_uploaded`
`files_uploaded_id` int(11)
`sesskey` varchar(32)
`customers_id` int(11)
`files_uploaded_name` varchar(64)
`abs_newsletters`
`newsletters_id` int(11)
`title` varchar(255)
`content` text
`content_html` text
`module` varchar(255)
`date_added` datetime
`date_sent` datetime
`status` int(1)
`locked` int(1)
`abs_email_archive`
`archive_id` int(11)
`email_to_name` varchar(96)
`email_to_address` varchar(96)
`email_from_name` varchar(96)
`email_from_address` varchar(96)
`email_subject` varchar(255)
`email_html` text
`email_text` text
`date_sent` datetime
`module` varchar(64)
`abs_coupons`
`coupon_id` int(11)
`coupon_type` char(1)
`coupon_code` varchar(32)
`coupon_amount` decimal(8,4)
`coupon_minimum_order` decimal(8,4)
`coupon_start_date` datetime
`coupon_expire_date` datetime
`uses_per_coupon` int(5)
`uses_per_user` int(5)
`restrict_to_products` varchar(255)
`restrict_to_categories` varchar(255)
`restrict_to_customers` text
`coupon_active` char(1)
`date_created` datetime
`date_modified` datetime
`abs_coupon_redeem_track`
`unique_id` int(11)
`coupon_id` int(11)
`customer_id` int(11)
`redeem_date` datetime
`redeem_ip` varchar(32)
`order_id` int(11)
`abs_coupons_description`
`coupon_id` int(11)
`language_id` int(11)
`coupon_name` varchar(32)
`coupon_description` text
`coupon_restrict`
`restrict_id` int(11)
`coupon_id` int(11)
`product_id` int(11)
`category_id` int(11)
`coupon_restrict` char(1)
to Products.
id INTEGER
to Categories
id INTEGER


`abs_orders_total`
`orders_total_id` int(10)
`orders_id` int(11)
`title` varchar(255)
`text` varchar(255)
`value` decimal(15,4)
`class` varchar(32)
`sort_order` int(11)
ORDERS
`abs_orders_session_info`
`txn_signature` varchar(32)
`orders_id` int(11)
`sendto` int(11)
`billto` int(11)
`language` varchar(32)
`currency` char(3)
`firstname` varchar(32)
`lastname` varchar(32)
`content_type` varchar(32)
`abs_orders_status_history`
`orders_status_history_id` int(11)
`orders_id` int(11)
`orders_status_id` int(5)
`date_added` datetime
`customer_notified` int(1)
`comments` text
`abs_orders_status`
`orders_status_id` int(11)
`language_id` int(11)
`orders_status_name` varchar(32)
to Language
id INTEGER
to Paypal
id INTEGER
`abs_orders`
`orders_id` int(11)
`customers_id` int(11)
`customers_name` varchar(64)
`customers_company` varchar(32)
`customers_street_address` varchar(64)
`customers_suburb` varchar(32)
`customers_city` varchar(32)
`customers_postcode` varchar(10)
`customers_state` varchar(32)
`customers_country` varchar(32)
`customers_telephone` varchar(32)
`customers_email_address` varchar(96)
`customers_address_format_id` int(5)
`delivery_name` varchar(64)
`delivery_company` varchar(32)
`delivery_street_address` varchar(64)
`delivery_suburb` varchar(32)
`delivery_city` varchar(32)
`delivery_postcode` varchar(10)
`delivery_state` varchar(32)
`delivery_country` varchar(32)
`delivery_address_format_id` int(5)
`billing_name` varchar(64)
`billing_company` varchar(32)
`billing_street_address` varchar(64)
`billing_suburb` varchar(32)
`billing_city` varchar(32)
`billing_postcode` varchar(10)
`billing_state` varchar(32)
`billing_country` varchar(32)
`billing_address_format_id` int(5)
`payment_method` varchar(32)
`coupon_code` varchar(32)
`cc_type` varchar(20)
`cc_owner` varchar(64)
`cc_number` varchar(32)
`cc_expires` varchar(4)
`cc_cvv` blob
`last_modified` datetime
`date_purchased` datetime
`orders_status` int(5)
`orders_date_finished` datetime
`currency` char(3)
`currency_value` decimal(14,6)
`order_total` decimal(14,2)
`order_tax` decimal(14,2)
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to Customers_ID
id INTEGER
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`orders_products_download_id` int(11)
`orders_id` int(11)
`orders_products_id` int(11)
`orders_products_filename` varchar(255)
`download_maxdays` int(2)
`download_count` int(2)
to Products
id INTEGER
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`orders_products_id` int(11)
`orders_id` int(11)
`products_id` int(11)
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`products_name` varchar(64)
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`final_price` decimal(15,4)
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`products_quantity` float
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`products_discount_type` tinyint(1)
`products_discount_type_from` tinyint(1)
`abs_orders_products_attributes`
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`options_values_price` 15,4)
`price_prefix` char(1)
`product_attribute_is_free` tinyint(1)
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`attributes_discounted` tinyint(1)
`attributes_price_base_included` tinyint(1)
`attributes_price_onetime` decimal(15,4)
`attributes_price_factor` decimal(15,4)
`attributes_price_factor_offset` decimal(15,4)
`attributes_price_factor_onetime` decimal(15,4)
`attributes_price_factor_onetime_offset` decimal(15,4)
`attributes_qty_prices` text
`attributes_qty_prices_onetime` text
`attributes_price_words` decimal(15,4)
`attributes_price_words_free` int(4)
`attributes_price_letters` decimal(15,4)
`attributes_price_letters_free` int(4)
`products_options_id` int(4)
`products_options_values_id` int(11)
to products_options_values
id INTEGER
to Products_Options
id INTEGER
`abs_salemaker_sales`
`sale_id` int(11)
`sale_status` tinyint(4)
`sale_name` varchar(30)
`sale_deduction_value` decimal(15,4)
`sale_deduction_type` tinyint(4)
`sale_pricerange_from` decimal(15,4)
`sale_pricerange_to` decimal(15,4)
`sale_specials_condition` tinyint(4)
`sale_categories_selected` text
`sale_categories_all` text
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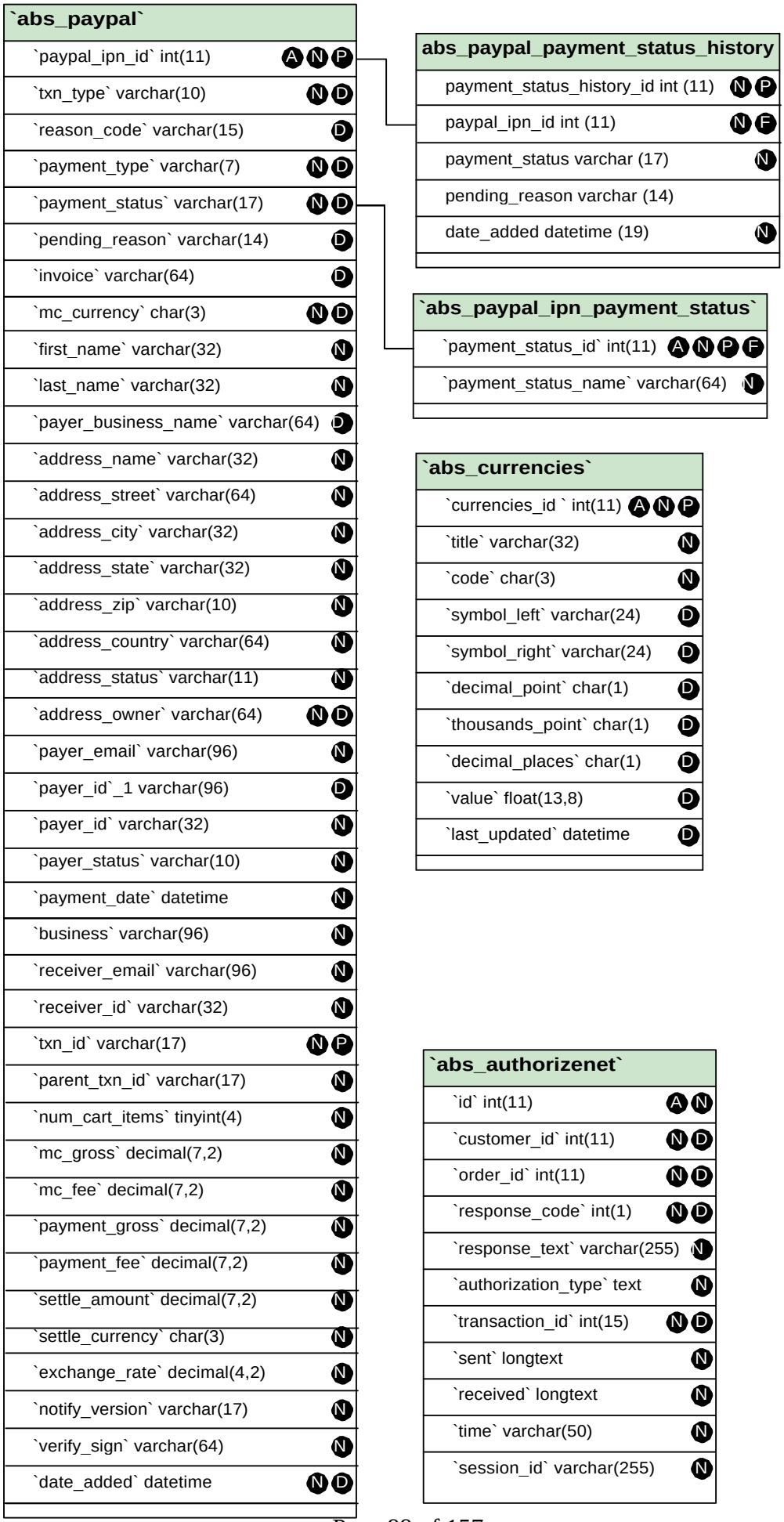
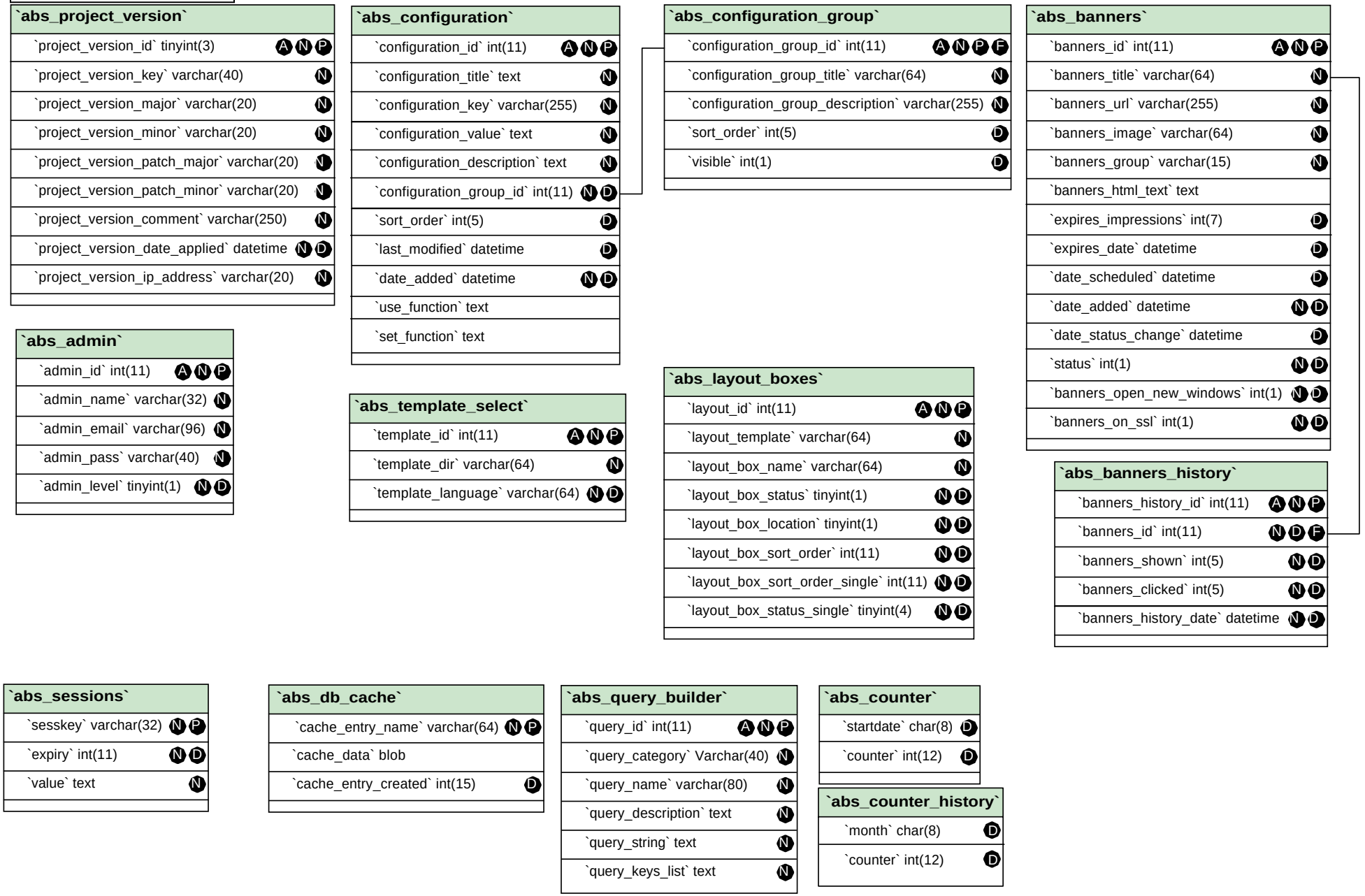
`sale_date_end` date
`sale_date_added` date
`sale_date_last_modified` date
`sale_date_status_change` date

PAYMENTS


`abs_paypal`
`paypal_ipn_id` int(11) A N P
`txn_type` varchar(10) N D
`reason_code` varchar(15) D
`payment_type` varchar(7) N D
`payment_status` varchar(17) N D
`pending_reason` varchar(14) D
`invoice` varchar(64) D
`mc_currency` char(3) N D
`first_name` varchar(32) N
`last_name` varchar(32) N
`payer_business_name` varchar(64) D
`address_name` varchar(32) N
`address_street` varchar(64) N
`address_city` varchar(32) N
`address_state` varchar(32) N
`address_zip` varchar(10) N
`address_country` varchar(64) N
`address_status` varchar(11) N
`address_owner` varchar(64) N D
`payer_email` varchar(96) N
`payer_id`_1 varchar(96) D
`payer_id` varchar(32) N
`payer_status` varchar(10) N
`payment_date` datetime N
`business` varchar(96) N
`receiver_email` varchar(96) N
`receiver_id` varchar(32) N
`txn_id` varchar(17) N P
`parent_txn_id` varchar(17) N
`num_cart_items` tinyint(4) N
`mc_gross` decimal(7,2) N
`mc_fee` decimal(7,2) N
`payment_gross` decimal(7,2) N
`payment_fee` decimal(7,2) N
`settle_amount` decimal(7,2) N
`settle_currency` char(3) N
`exchange_rate` decimal(4,2) N
`notify_version` varchar(17) N
`verify_sign` varchar(64) N
`date_added` datetime N D
abs_paypal_payment_status_history
payment_status_history_id int (11) N P
paypal_ipn_id int (11) N F
payment_status varchar (17) N
pending_reason varchar (14)
date_added datetime (19) N
`abs_paypal_ipn_payment_status`
`payment_status_id` int(11) A N P F
`payment_status_name` varchar(64) N
`abs_currencies`
`currencies_id ` int(11) A N P
`title` varchar(32) N
`code` char(3) N
`symbol_left` varchar(24) D
`symbol_right` varchar(24) D
`decimal_point` char(1) D
`thousands_point` char(1) D
`decimal_places` char(1) D
`value` float(13,8) D
`last_updated` datetime D
`abs_authorizenet`
`id` int(11) A N
`customer_id` int(11) N D
`order_id` int(11) N D
`response_code` int(1) N D
`response_text` varchar(255) N
`authorization_type` text N
`transaction_id` int(15) N D
`sent` longtext N
`received` longtext N
`time` varchar(50) N
`session_id` varchar(255) N

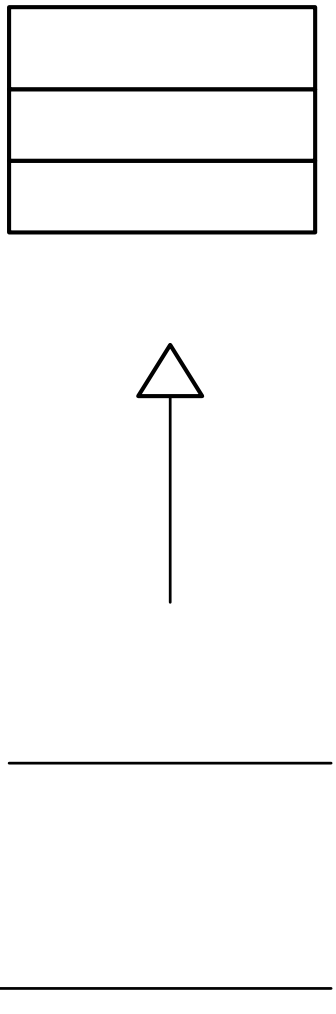
CONFIGURATION

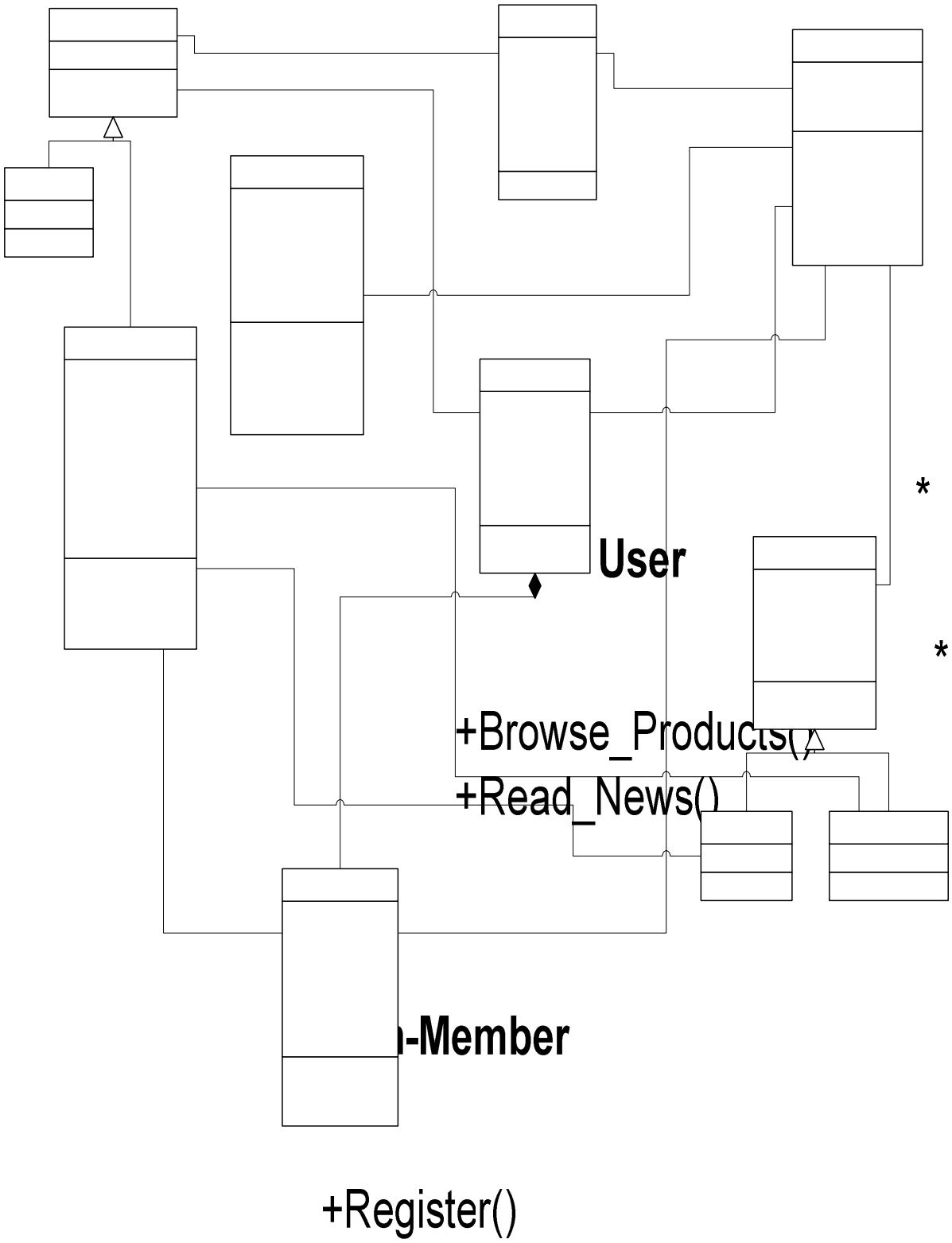


4.3 OBJECT ORIENTED DESIGN

4.3.1 Static Object Model

Legend

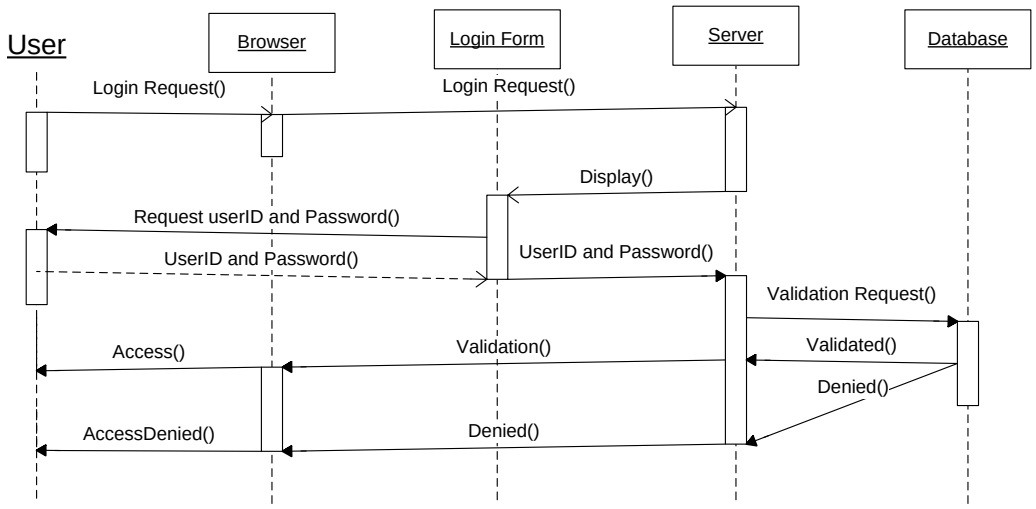



User
*
*
+Browse_Products()
+Read_News()
-Member
+Register()
-image
-name
-impress
-clicks
-URL
-view

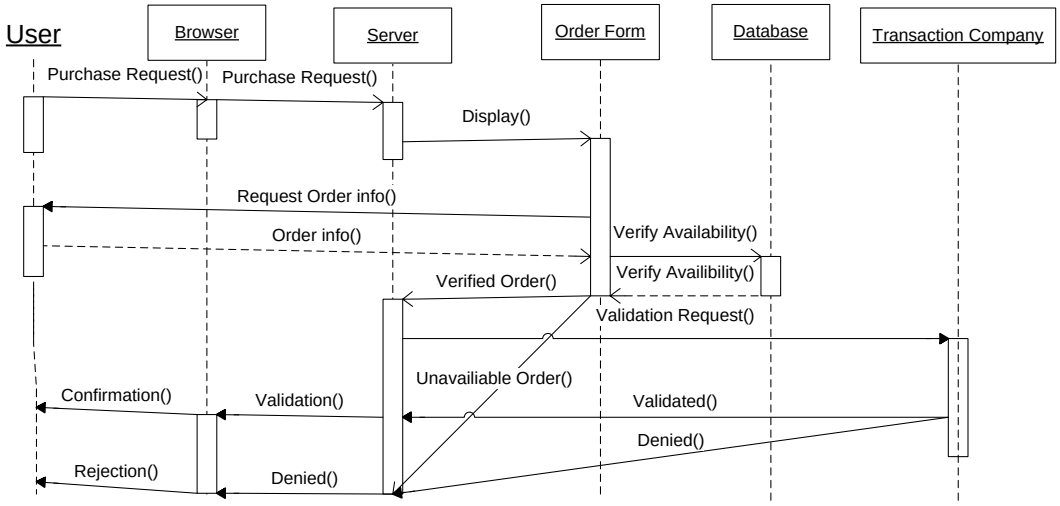
4.3.2 Dynamic Modeling

4.3.2.1 Sequence Diagrams

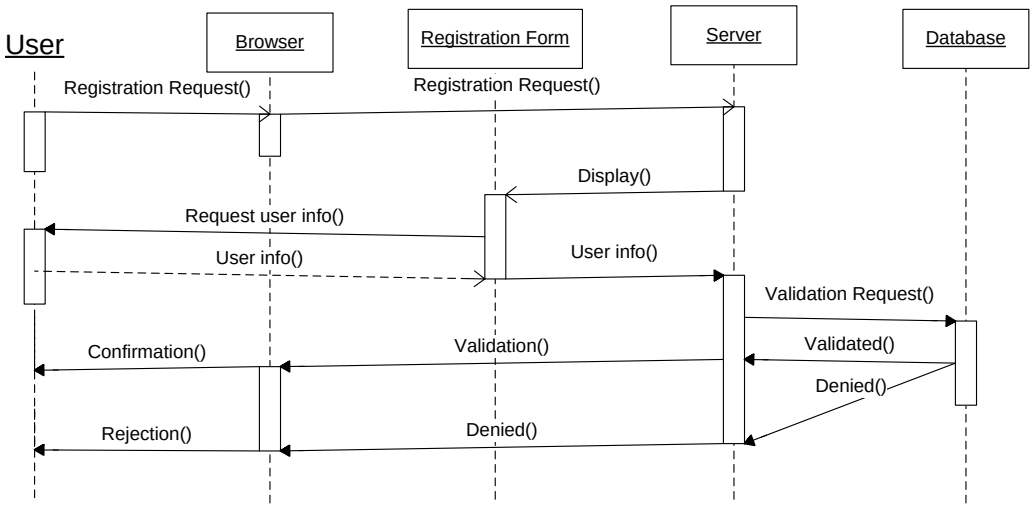
Login



Purchase

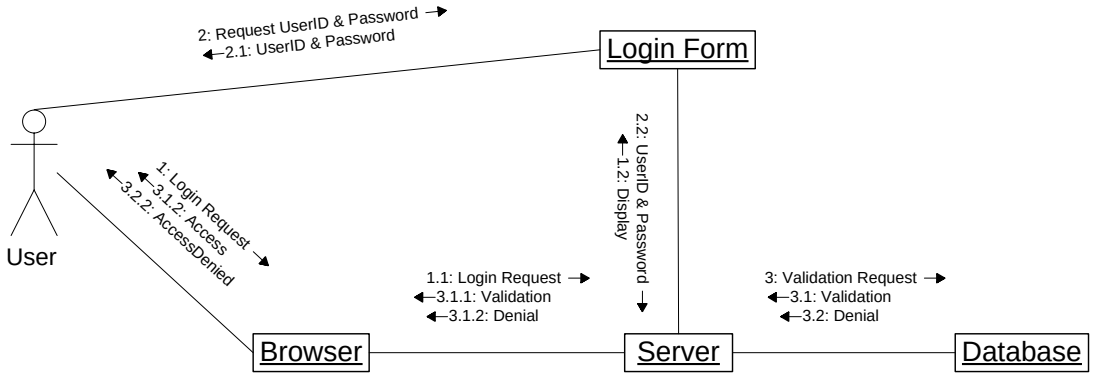


Registration

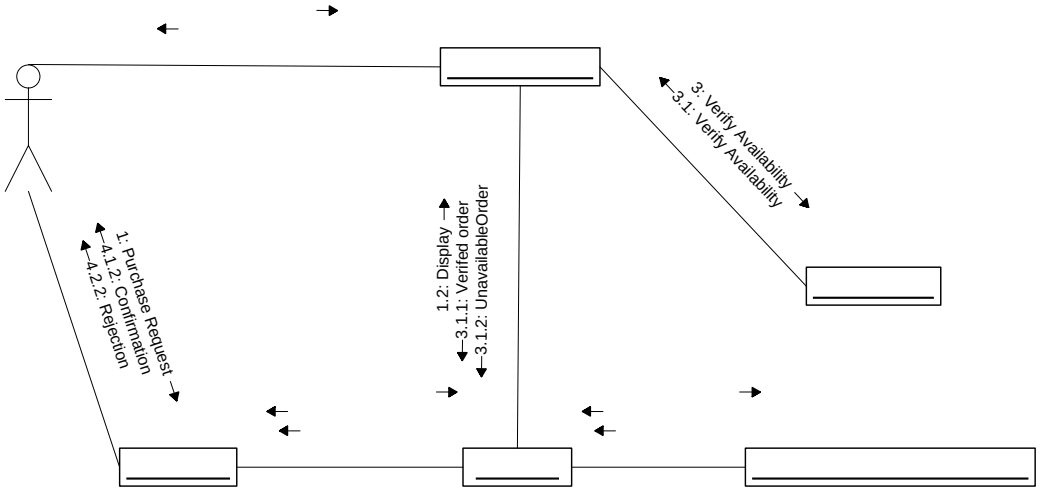


4.3.2.2 Collaboration Diagrams

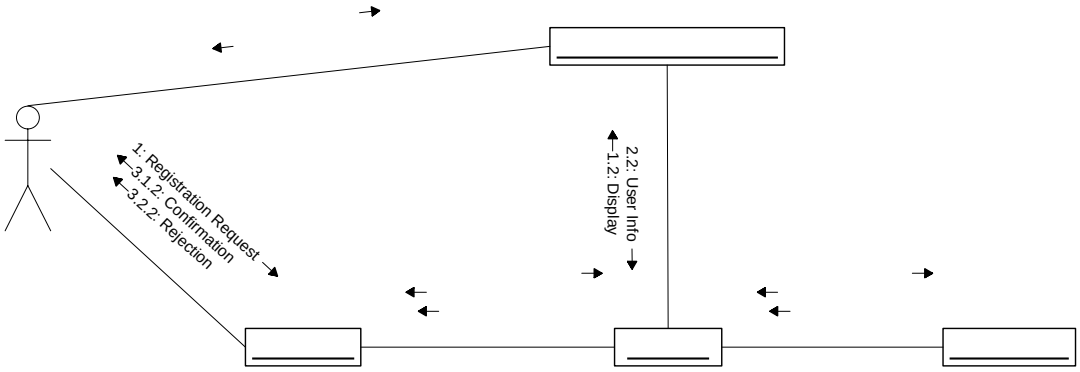
Login



Purchase



Registration

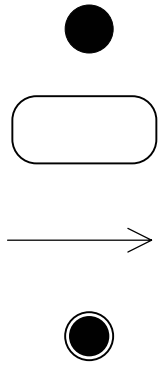


2: R

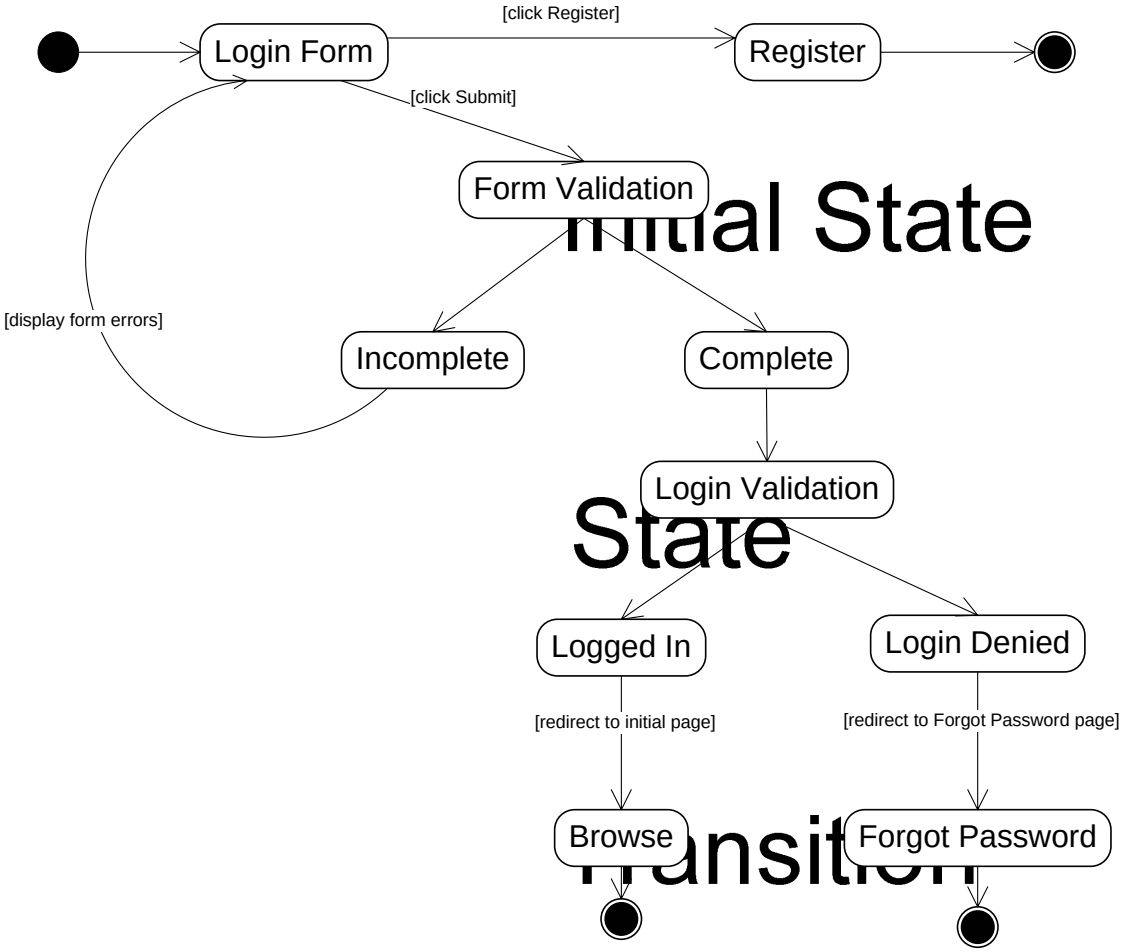
Non- Member

4.3.2.3 State Transition Diagrams

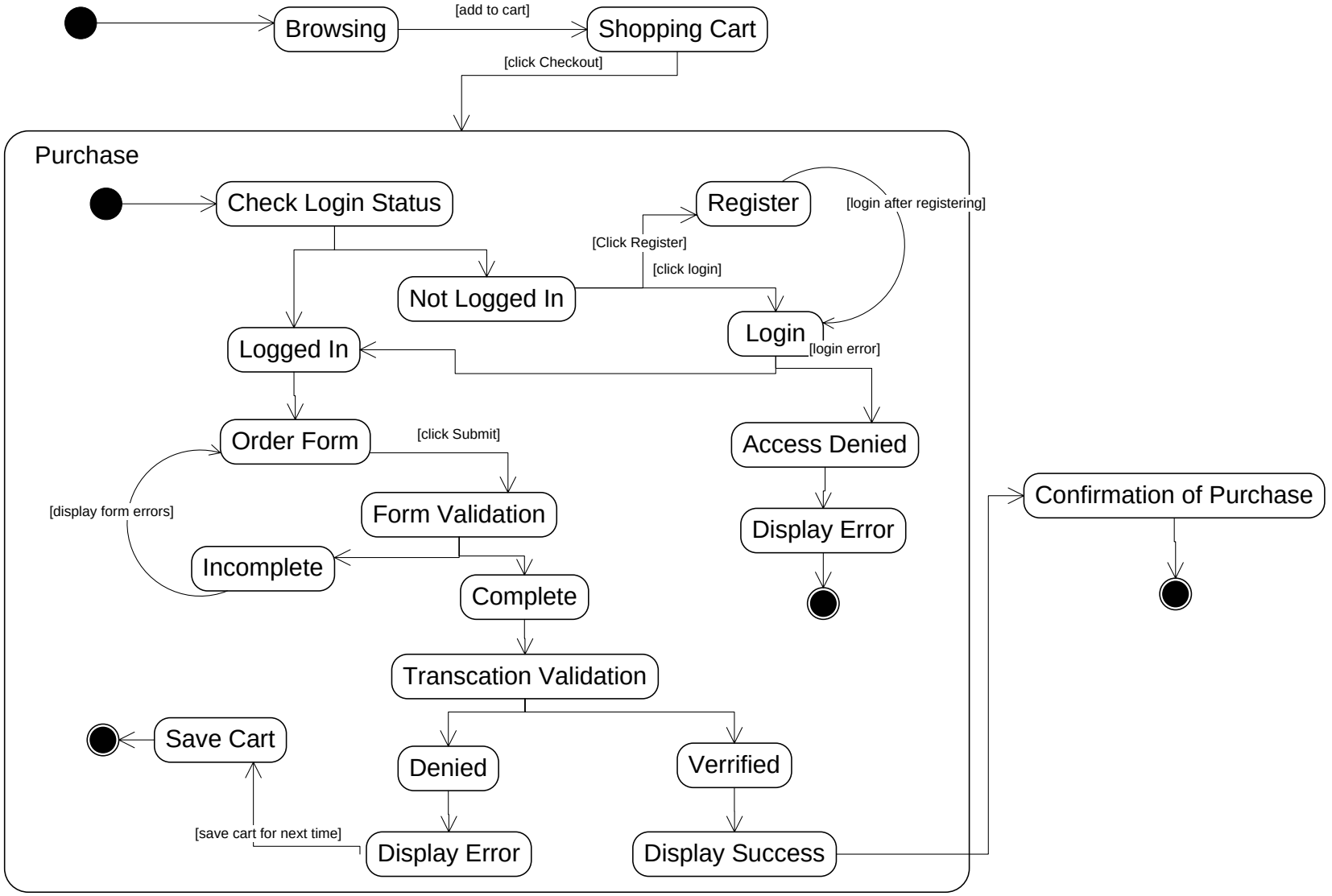
Legend



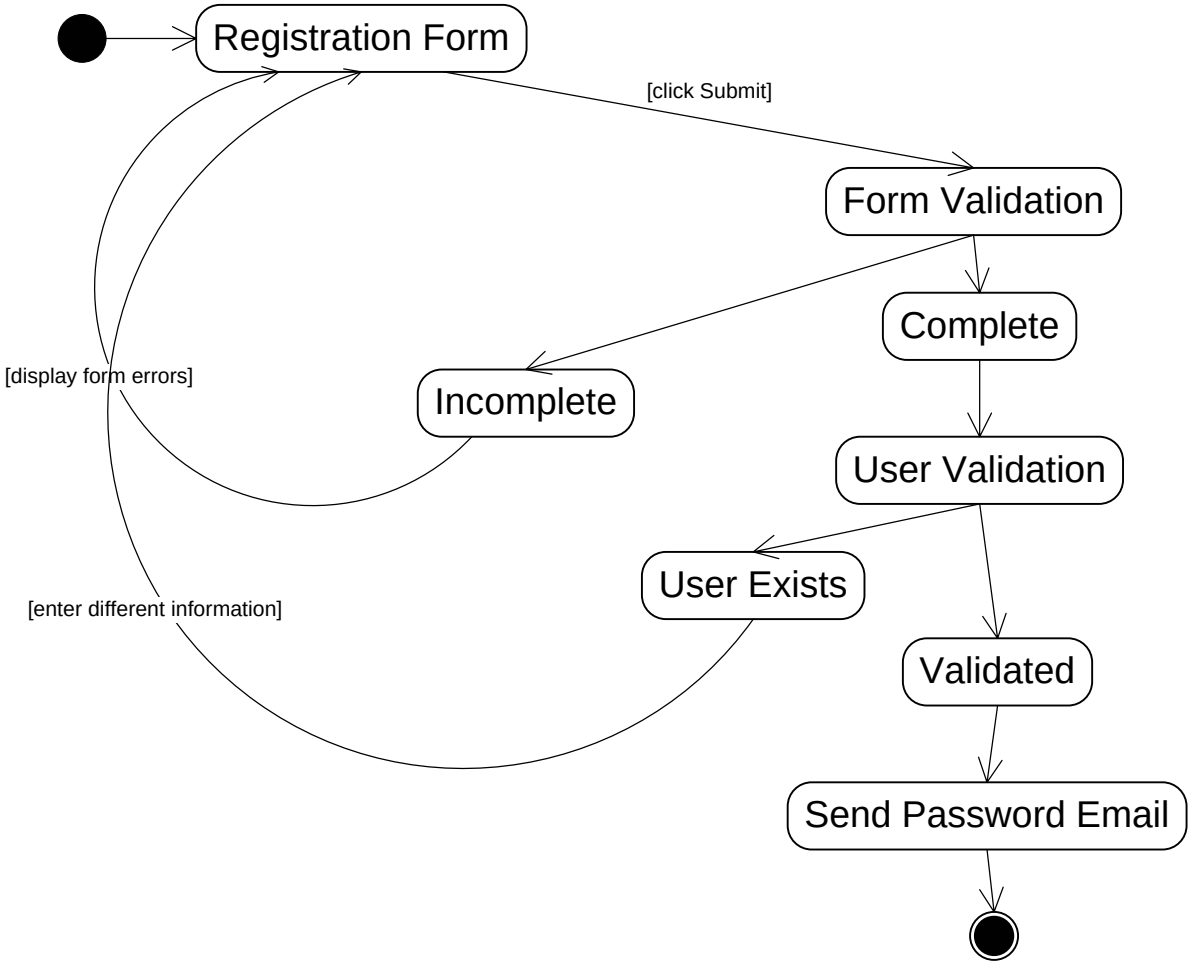
Log In



Purchase


Browsing
[add to cart]
Shopping Cart
[click Checkout]
Purchase
Check Login Status
Register
[login after registering]
[Click Register]
[click login]
Not Logged In
Login
[login error]
Logged In
Order Form
[click Submit]
Access Denied
[display form errors]
Form Validation
Display Error
Incomplete
Complete
Transcation Validation
Save Cart
Denied
Verrified
[save cart for next time]
Display Error
Display Success
Confirmation of Purchase

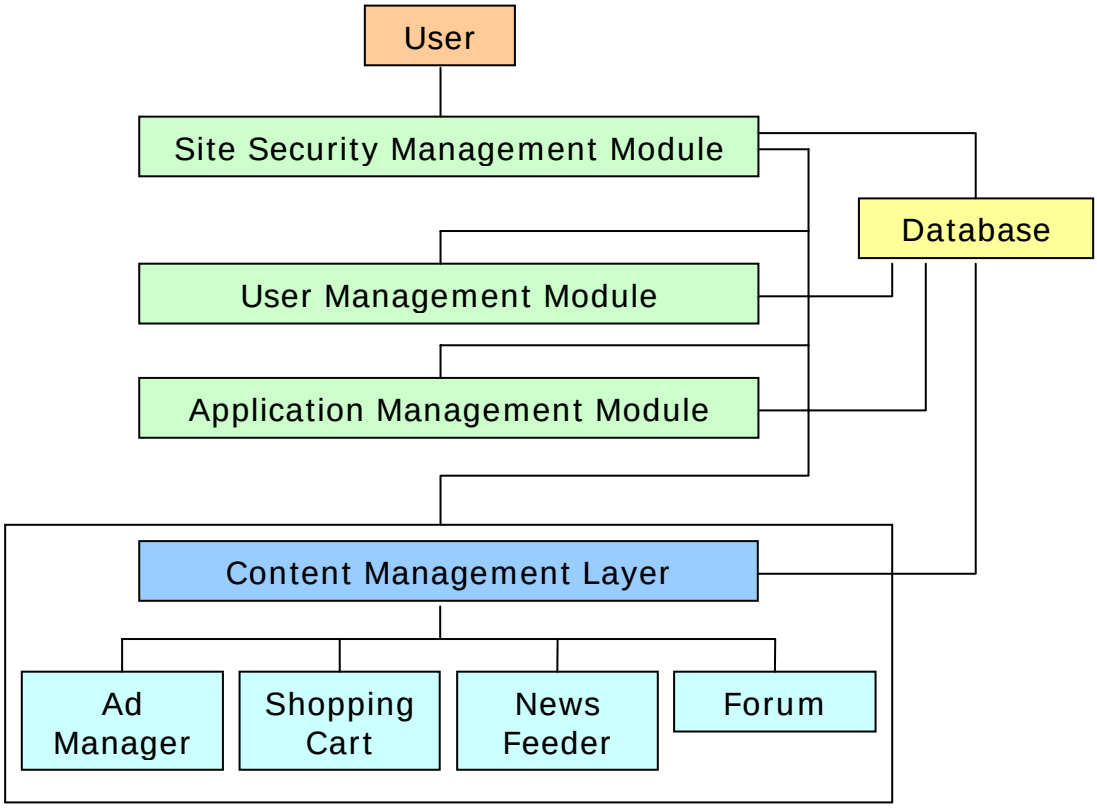
Register


Registration Form
[click Submit]
Form Validation
Complete
[display form errors]
Incomplete
User Validation
User Exists
[enter different information]
Validated
Send Password Email

4.4 ARCHITECHTURAL DESIGN

4.4.1 System Structure

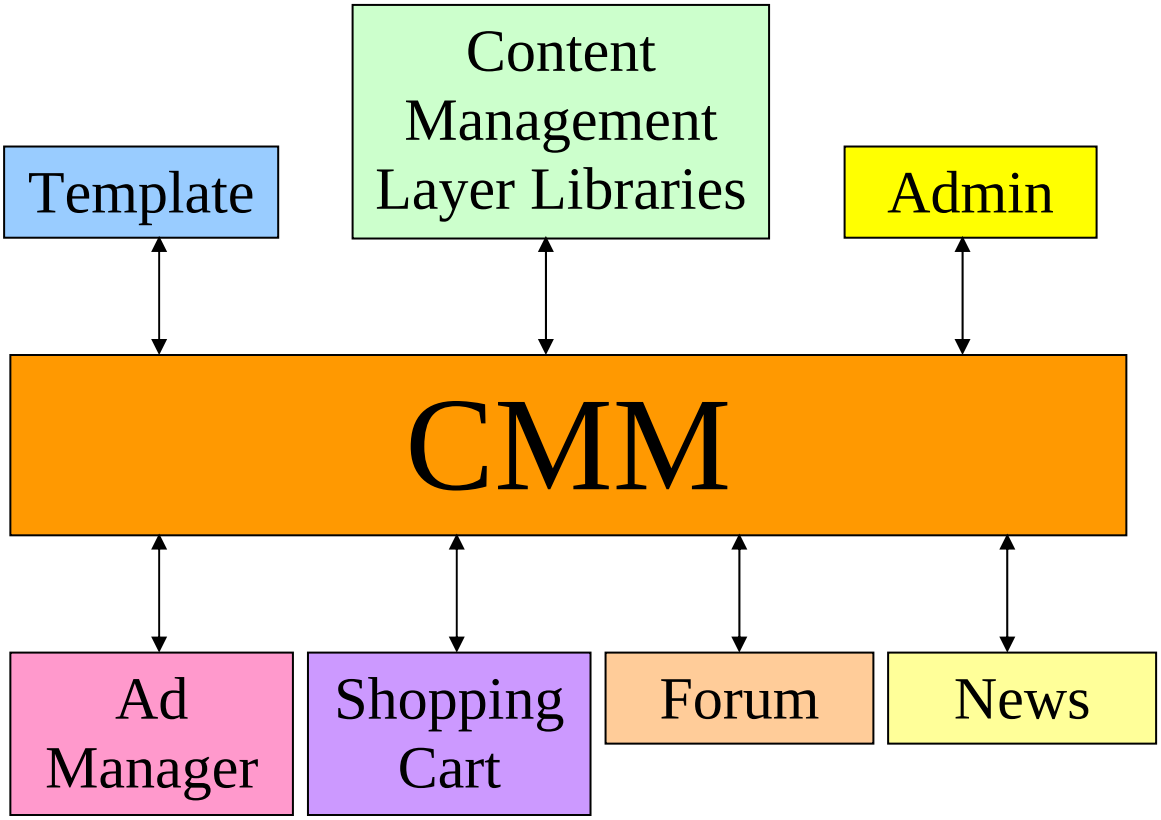
The System Structure of this project is complex as there are four modules involved and the system must be designed with integration in mind. There must be loose coupling between modules and tight cohesion within each module. The following diagram shows the structure of the entire project and where the Content Management Module fits into the overall system.



Now we will discuss various modeling strategies for the Content Management Module. These will include the Repository Model, Client Server Model and Abstract Machine Model.

4.4.1.1 The Repository Model

The Repository Model shares information via sub-systems that directly communicates with local databases.



Advantages:

- This modeling technique efficiently shares large amount of data that would otherwise be incomprehensible by utilizing other models.

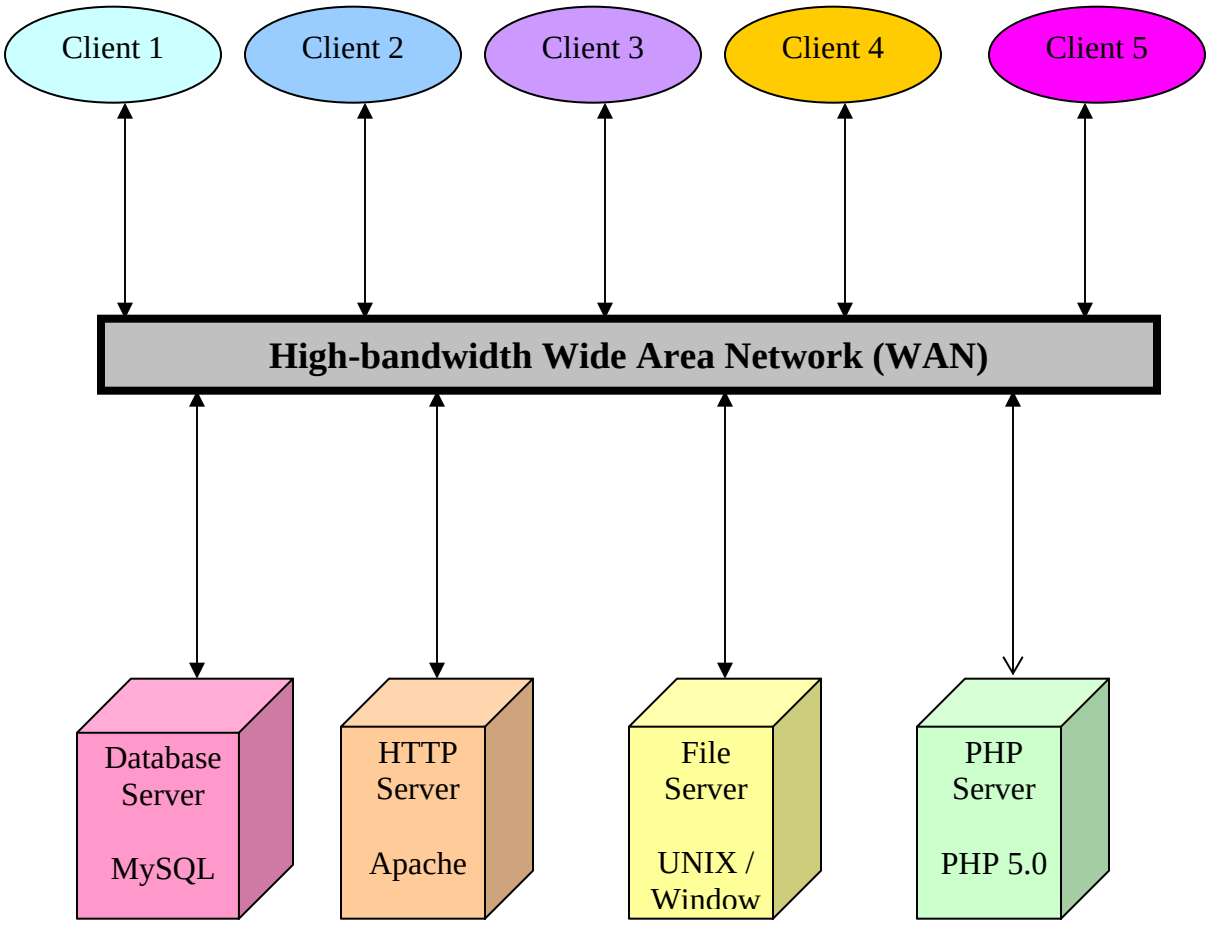
Disadvantages:

- All Sub-systems must also share the same repository data model
- Difficult to evolve the system
- Problem with fault tolerance
- Different sub-systems may have different requirements

4.4.1.2 The Client-Server Model

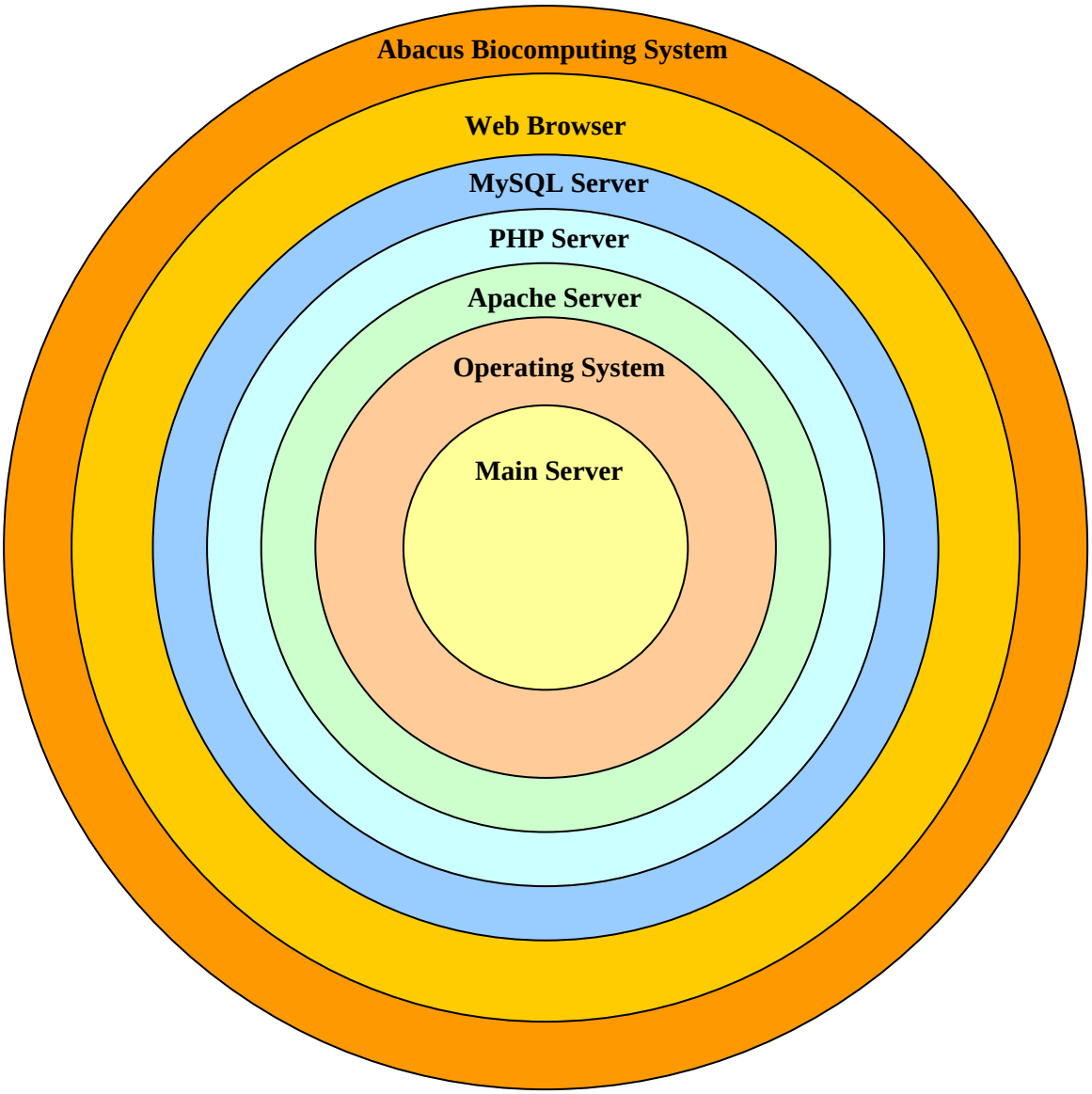
Functionalities:

- A set of stand-alone *servers* that offer services to other sub-systems
- A set of *clients* which call on the services provided by the server
- A *network* that allows the clients to communicate with servers and have access to the services, which they provide.



4.4.1.3 The Abstract Machine Model

The Abstract Machine Model uses a layered approach to organize systems that provide a set of services. Each layer defines an *abstract machine*. The abstract machine model supports incremental development of systems.



Advantages:

- Portable and Changeable.

Disadvantages:

- Difficult to structure system.
- Performance may be reduced.

4.5 USER INTERFACE DESIGN

4.5.1 HCI Design

What is HCI? According to ACM SIGCHI, HCI stands for *Human Computer Interaction* and is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. (http://sigchi.org/cdg/cdg2.html#2_1 Copyright © 1992, 1996 ACM SIGCHI). We used the eight golden rules of HCI in our project.

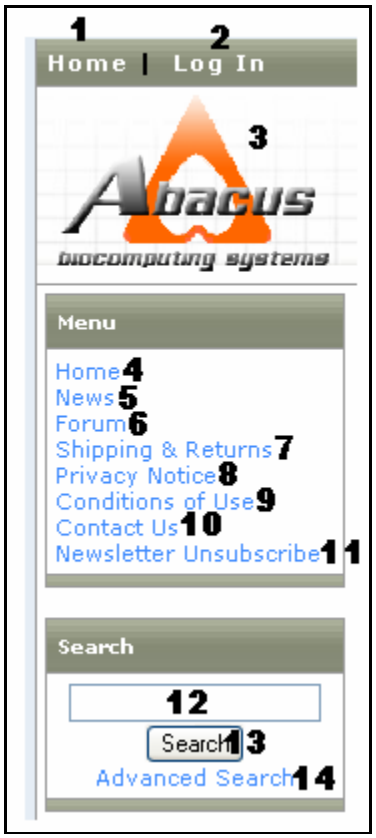
1. Strive for Consistency - The layout scheme, color, font size and color remains consistent throughout the entire site.

Layout menu boxes

2. Reduce Short-term Memory Load - We are using the concept of chunking to reduce the user's short term memory load. We present the information in small digestible units of no more then nine elements for each box.

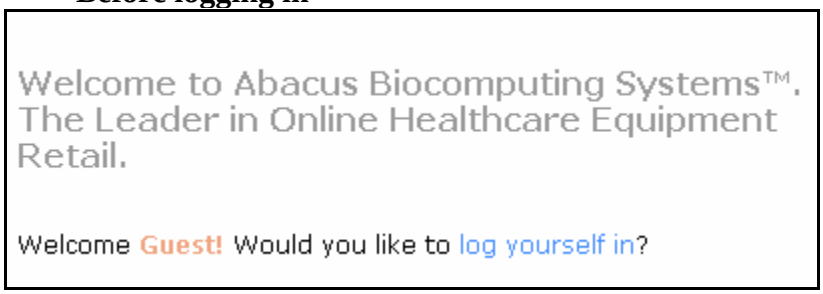
Menu boxes

3. Enable frequent users to use Shortcuts - We're using the tab in sequence starting from the top left progressing downward.

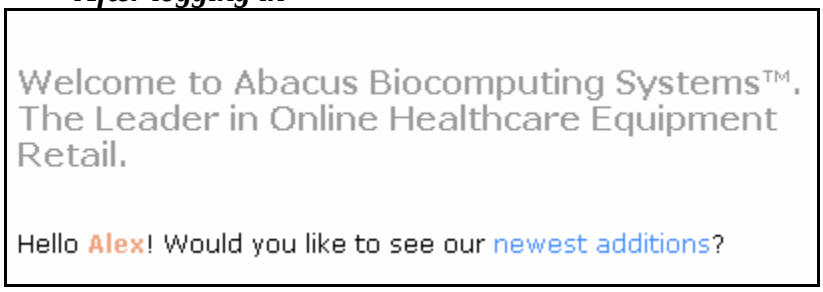


4. Informative Feedback- Contents change dynamically depending on the user's state. Here we see that before logging in the message simply says "Welcome Guest!" since we do not know the user. After logging in we know who the user is so we greet the user with the message "Hello Alex!" giving the user a more customized feel.

Before logging in

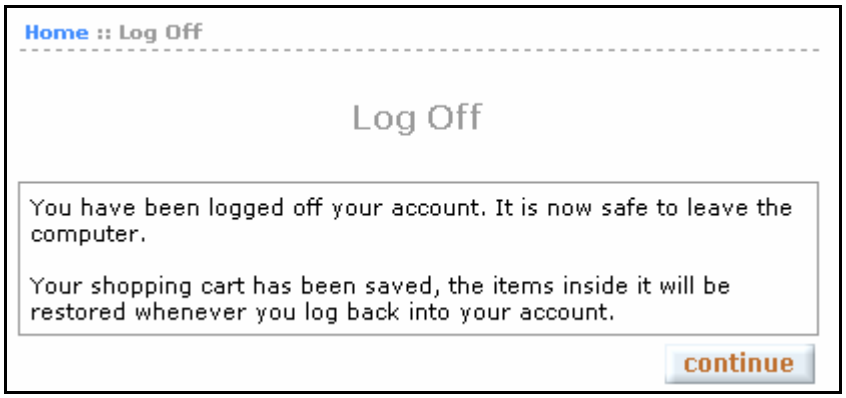


After logging in



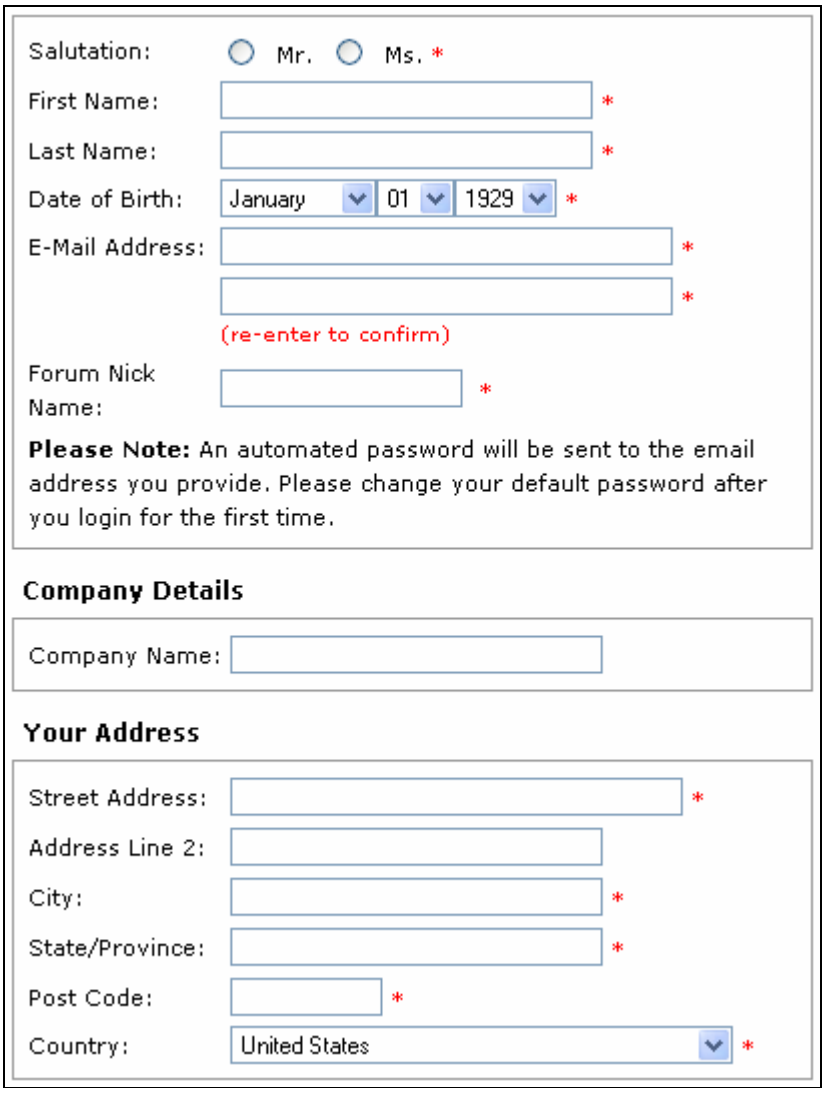
5. Design Dialogs to Yield Closure – When the user logs off the system, we tell that user that he has been logged off and everything in his shopping cart has been saved for future purchase when he returns. This message implies that the user's session has officially ended and that the user can safely leave the computer.

Feedback

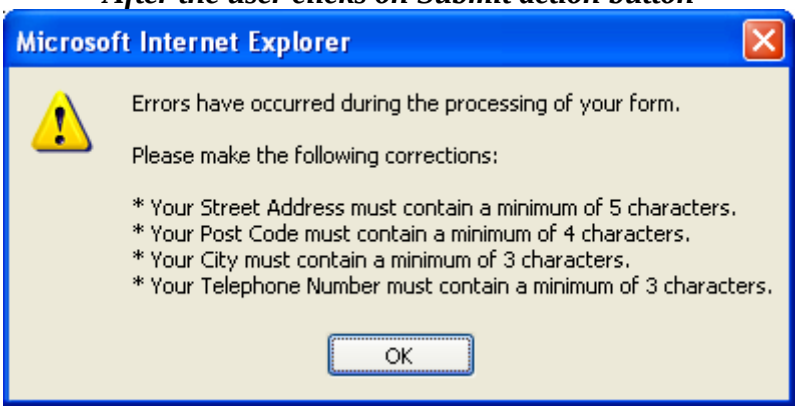


6. Offer Error Prevention & Simple Error Handling – If the user does not completely fall out the registration form we check for missing data and if required data is missing we send a message box to the user listing missing information. Refer to Error Prevention screen shots. Once the check for missing data has been done, we check whether correct data has been entered by verifying the data with the format in our data definition PHP file. Refer to Simple Error Handling screen shots.

Error Prevention

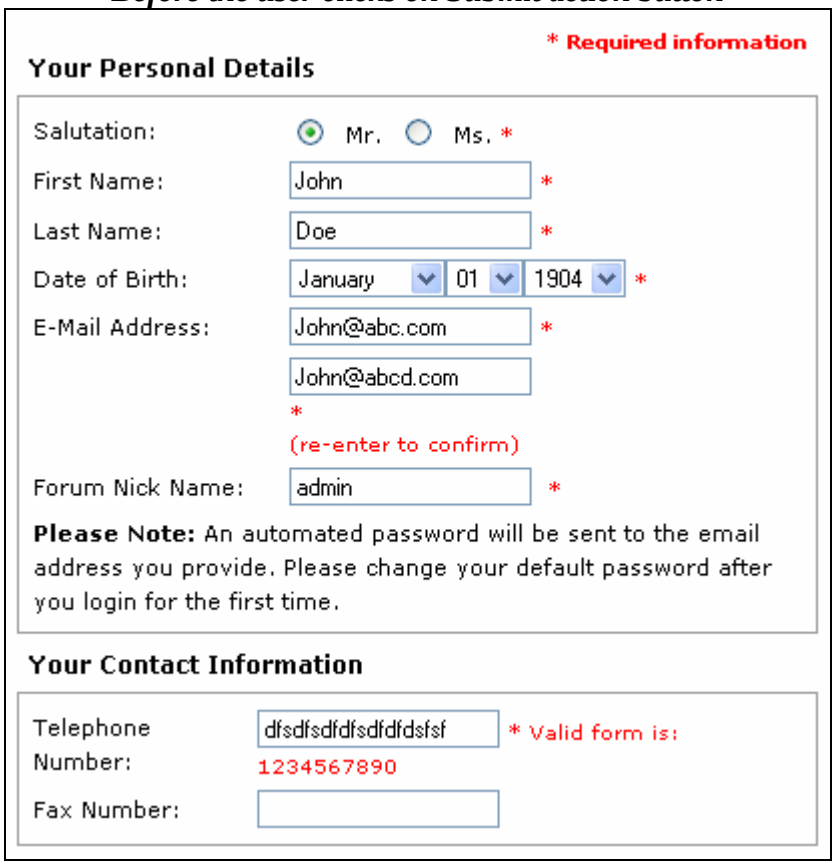


After the user clicks on Submit action button



Simple Error Handling

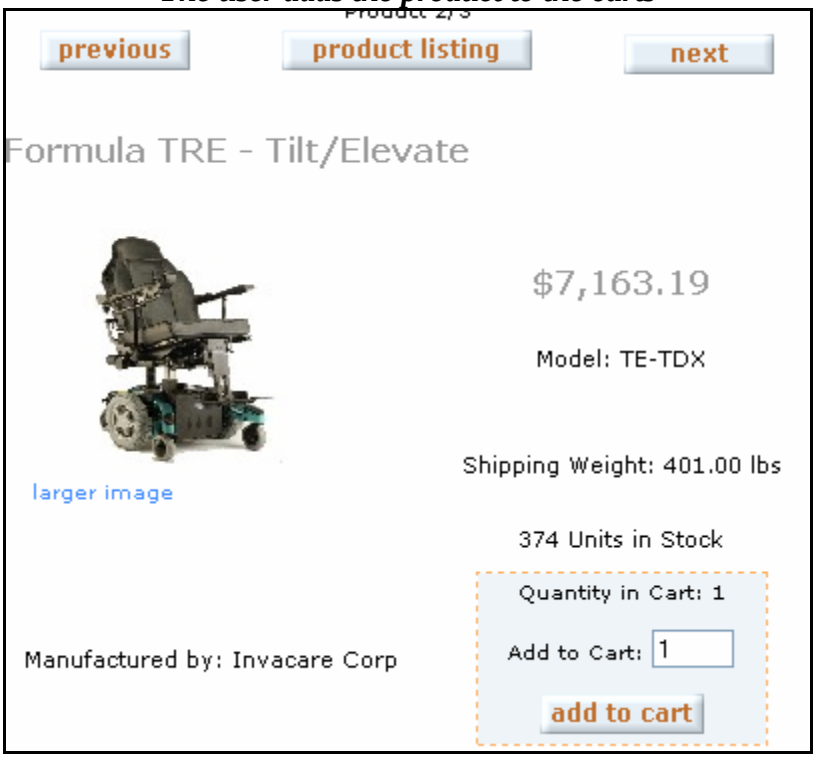
Before the user clicks on Submit action button



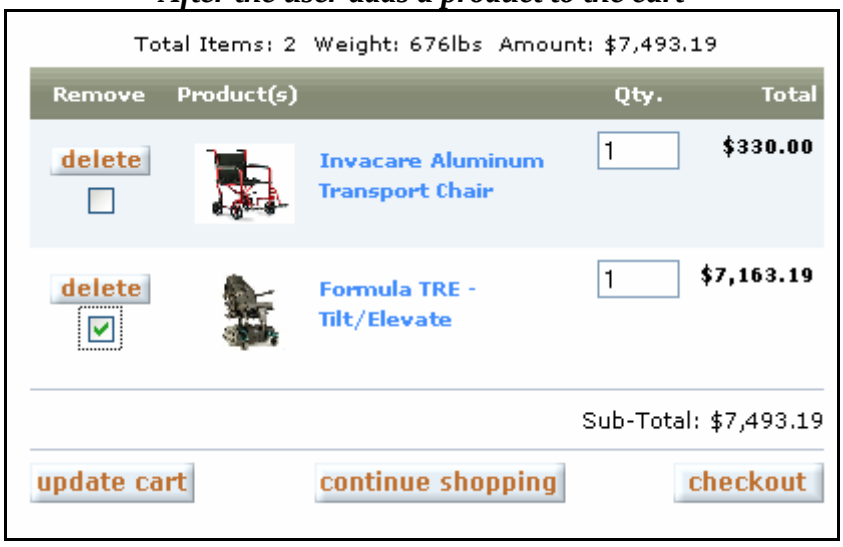
After the user clicks on Submit action button

7. Permit Easy Reversal of Actions – The user can add and remove any product from the cart at any time. Any action can easily be reversed as demonstrated by the screen shots below.

The user adds the product to the carts



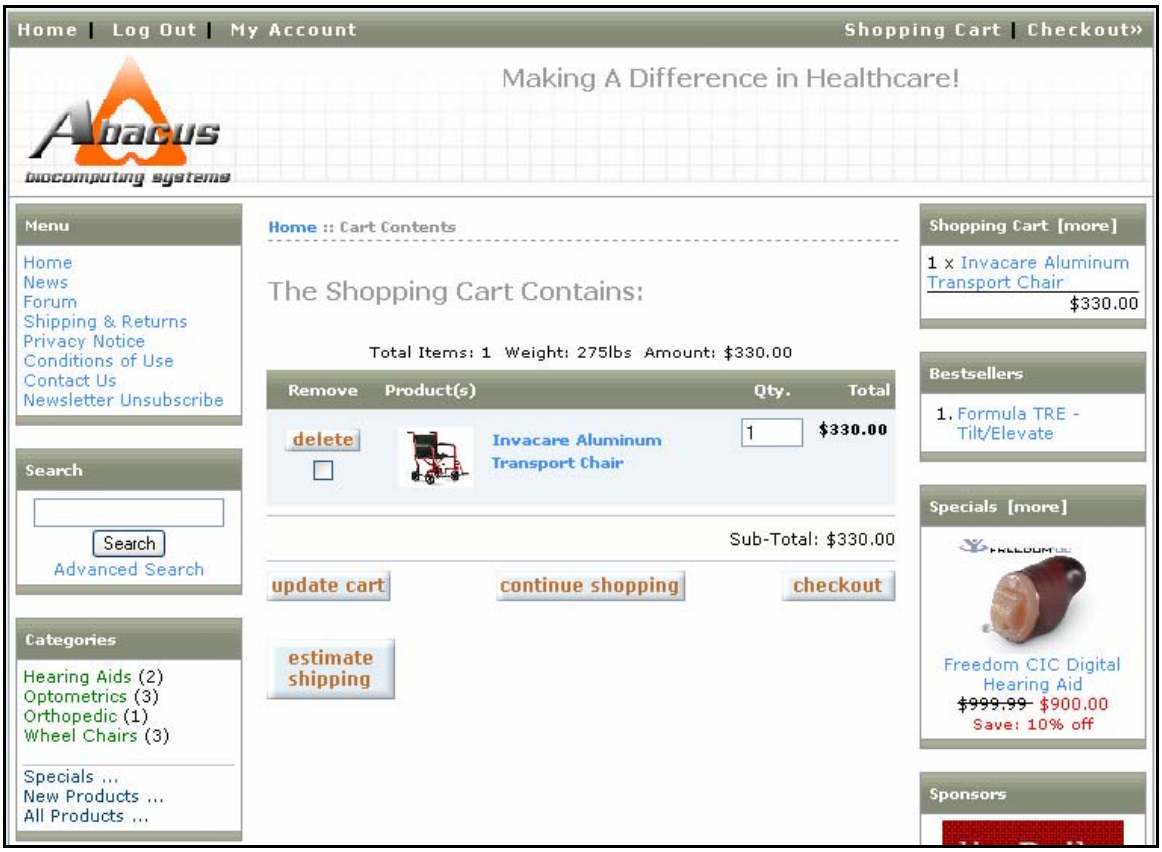
After the user adds a product to the cart



After the user removes the unwanted product from the cart

8. Support Internal Locus of Control – We have the logo on the top left, the menu, search, and categories are on the left hand side. We have the shopping cart status, bestsellers, specials and sponsors on the right hand side. The user's focus of attention goes from the top left to right.

Main website



Testing

5. TESTING

The formal test case documentation was created for the testing requirements of Content Management Module, which is part of the Abacus Biocomputing Systems. The test cases use the functional requirements as its objectives to determine if the system fulfills the requirements set by the sponsors of the ABS project. The test cases will be broken up into two parts: the customer part and the administrator part. The testers will be allowed to perform ad hoc testing to ensure the stability of the CMM system as well as the overall appearance, functionality, and performance times.

The testing will be performed from different operational systems to ensure backward compatibility of the Content Management Module of the Abacus Biocomputing Systems. Still, the main testing environment will be done on the Windows platform since most of the world uses Microsoft products such as Internet Explorer. The tests will include step-by-step procedures that can be followed to recreate the testing phase of the ABS project. To guarantee that testing is not too structured, some steps will require the user to enter random data or choose any possible way to navigate to a particular part of the website. The administrator site testing will be performed along with the user site testing to see if the user activity is properly recorded and displayed to the administrator at real time.

The test cases contain the test case creator, creation date, test date, objectives to be tested, and setup requirements that need to be fulfilled in order to start the test case. The test case steps are separated into rows that a tester follows and tests at the same time. He/she will record a pass or fail in the Pass/Fail column. Finally, the test case will have a generic area at the end of each test case that allows the tester to write any additional defects that were found during the testing phase.

5.1 TEST CASES

5.1.1 Test Case #1

Objectives	The user needs to be able to register to the website, browse around for products, use a shopping cart and checkout and logout properly
Setup	Windows operation system with either Internet Explorer or Netscape Navigator installed. The user cannot be registered at the ABS website prior to this test.
Creator	Dariusz Bystrowski
Date	November 29, 2004
Tester 1	Nolan Castillo
Tester 2	Max Das
Tester 3	Vincent Mustacchio
Test Date	December 2, 2004

#	Steps	**Tester 1 P/F**	**Tester 2 P/F**	**Tester 3 P/F**
1	Open a browser and type in pegasus.rutgers.edu/~maxdas/	P	P	P
2	Click all the links, buttons and banners on the page to make sure that all of them function	P	P	P
3	Navigate to the login section of the website by clicking Log In link	P	P	P
4	Fill out the registration form with valid data and click on Submit. The user should receive registration confirmation on the web page and via e-mail.	P	P	P
5	Click on the specials deal found on the main page and add it to your shopping cart.	P	P	P
6	Add couple more products by browsing the page via different links. Observe if each product has a description and a review section.	P	P	P
7	Click on the Shopping Cart button. Examine if the shopping cart displays the correct data and if all the links work. Change some of the product quantities to 2 or 3.	P	P	P
8	Click on the Estimate Shipping button and make sure the user is able to look up different shipping rates.	F	F	F
9	Click on the Checkout Button or link. A user should be placed in the checkout process. A user should be able to change shipping address and add additional instructions for the shipping company. Click on Continue button.	P	P	P
10	Enter 4111111111111111 in the Card Number field. Choose any future Expiration Date and enter any three numbers in the Validation field. Examine the content of the checkout process if they are correct such as links and displayed information. Click	P	P	P

	on Continue button.			
11	Examine all the displayed information if it is correct and see if the Edit button functionality works for each section. User should be able to go back to the shopping cart and update quantities or add more products. Click on the confirm button	P	P	P
12	A transaction confirmation displays and user also gets an e-mail notification about the current transaction in the e-mail account specified by the user.	P	P	P
13	Click on the My Account link on the top. Preview your order. Try to change some information about your account.	P	P	P

Comments / Ad hoc Defects

5.1.2 Test Case #2

Objectives	The user needs to be able to browse freely through the website, use the news feeders and forums and search product functionalities without any errors.
Setup	Windows operation system with either Internet Explorer or Netscape Navigator installed. The user needs to be registered at the ABS website prior to this test.
Creator	Dariusz Bystrowski
Date	November 29, 2004
Tester 1	Nolan Castillo
Tester 2	Max Das
Tester 3	Vincent Mustacchio
Test Date	December 2, 2004

#	Steps	**Tester 1 P/F**	**Tester 2 P/F**	**Tester 3 P/F**
1	Open a browser and type in pegasus.rutgers.edu/~maxdas/	P	P	P
2	Examine the main page for any spelling errors, mistakes. Click on the Forum Link in the menu section. A new window should open up. You should not be able to post any threads without logging in.	P	P	P
3	Click on the Log In link on the top of the page. It should take you back to the registration page that is accessible from the main page. Log in with your account information.	P	P	P
4	In order to stress extra security, every user of ABS website needs to log in to forum again after logging in at the main log in section. To test this, click on Forum link from main page and try to post a thread. You should not be able to post anything without one extra log in.	P	P	P
5	Log in to the Forum using your forum nickname and ABS password.	P	P	P
6	Once Log in, test all the links, threads and post a thread.	P	P	P
7	Close the window and open a new browser window. Open ABS main website. Click on the News link in the Menu section.	P	P	P
8	News page opens with current date news from many different news feeds.	P	P	P
9	Examine the news headings. Click on couple news headings. They should contract. Click again on the same news heading. It expends. Also click on hide/expand on the top of the news feed. It has the same functionality for the entire news feed.	P	P	P
10	Click on news feed provided such as Yahoo! News: Health link in gray. It should take you directly to news.	P	P	P

11	Go back to the ABS web site and click on the search section. Type in some medical device keywords to test the search engine on the webpage. E.g.: Eye, wheelchair, bone, dog, jajca, etc. The search engine finds products relevant to the search keywords.	P	F	F
12	After a successful keyword search, a page with relevant products appears. Click on the Image or product link. It should take you to the product description page.	P	P	P

Comments / Ad hoc Defects

5.1.3 Test Case #3

Objectives	Verify the administrative functionalities and the real time interaction between the user interface and administrator interface.
Setup	Windows operation system with either Internet Explorer or Netscape Navigator installed. Two browse windows need to be opened.
Creator	Dariusz Bystrowski
Date	November 29, 2004
Tester 1	Nolan Castillo
Tester 2	Max Das
Tester 3	Vincent Mustacchio
Test Date	December 2, 2004

#	Steps	**Tester 1 P/F**	**Tester 2 P/F**	**Tester 3 P/F**
1	In first browser window navigate to pegasus.rutgers.edu/~maxdas/admin... Log in using below information: Admin Username: admin Admin Password: *********	P	P	P
2	In the second browser window, navigate to the log in as a user at the ABS web site.	P	P	P
3	In the first window, examine the administrator home page for any spelling errors. There should be four tables below the menu bar. Examine all the menu windows that they expand.	P	P	P
4	From tools menu bar, select Banner manager.	P	P	P
5	Banner manager page opens with statistics about clicks on banners. Observe and record the banner clicks for each banner.	P	P	P
6	From the second window, click on a banner. A new browser window should open up and display the sponsor's website.	P	P	P
7	Go back to the ABS website window and hit F5 to refresh the page. A random set of banners should load. Click on any banner. Repeat the process couple times.	P	P	P
8	Afterwards, refresh the banner manager window in the second browser window and examine the clicks for each banner. They should have increased. Click on the graph icon under the Action banner.	P	P	P
9	A new page opens with a graph of click activity of the viewed banner. There is a detailed graph and a daily click activity table. From Catalog menu bar, select Reviews.	P	P	P
10	In the first browser window, post a review for any product.	P	P	P

11	After posting a review, refresh the Review page in the second browser window. It should display a new review submitted for an approval.	P	P	P
12	Approve the review by clicking on the green light in the Status column.	P	P	P
13	In the first browser window, the user should be able to preview his recently posted review.	P	P	P

Comments / Ad hoc Defects

5.2 RESULTS

Test Case #1:

Tester #1 #2 and #3: Failed on Step #8 because the web page does not display different shipping rates.

Test Case #2:

Tester #1: Found no Defects

Tester #2 and #3: Step #11 failed since the search engine did not display the proper products.

Test Case #3:

Tester #1: Found no Defects

Tester #2: Found no Defects

Tester #3: Found no Defects

Ad hoc defects and comments for improvement:

Slow log in time and need for better form validation rules such as limit on the quantity entered for a reserved product.

Also the search engine needs an upgrade since its capabilities are very poor.

In the news section, when clicked on news source link, a new window should open the link instead of the same window opening the news link.

Implementation

6. IMPLEMENTATION (SCREEN SHOTS)

The implemented application can be viewed at the following URL but the availability of that URL cannot be guarnteed beyond six months since the date of this report.

http://www.pegasus.rutgers.edu/~maxdas

Below are Screen Shots from the site.

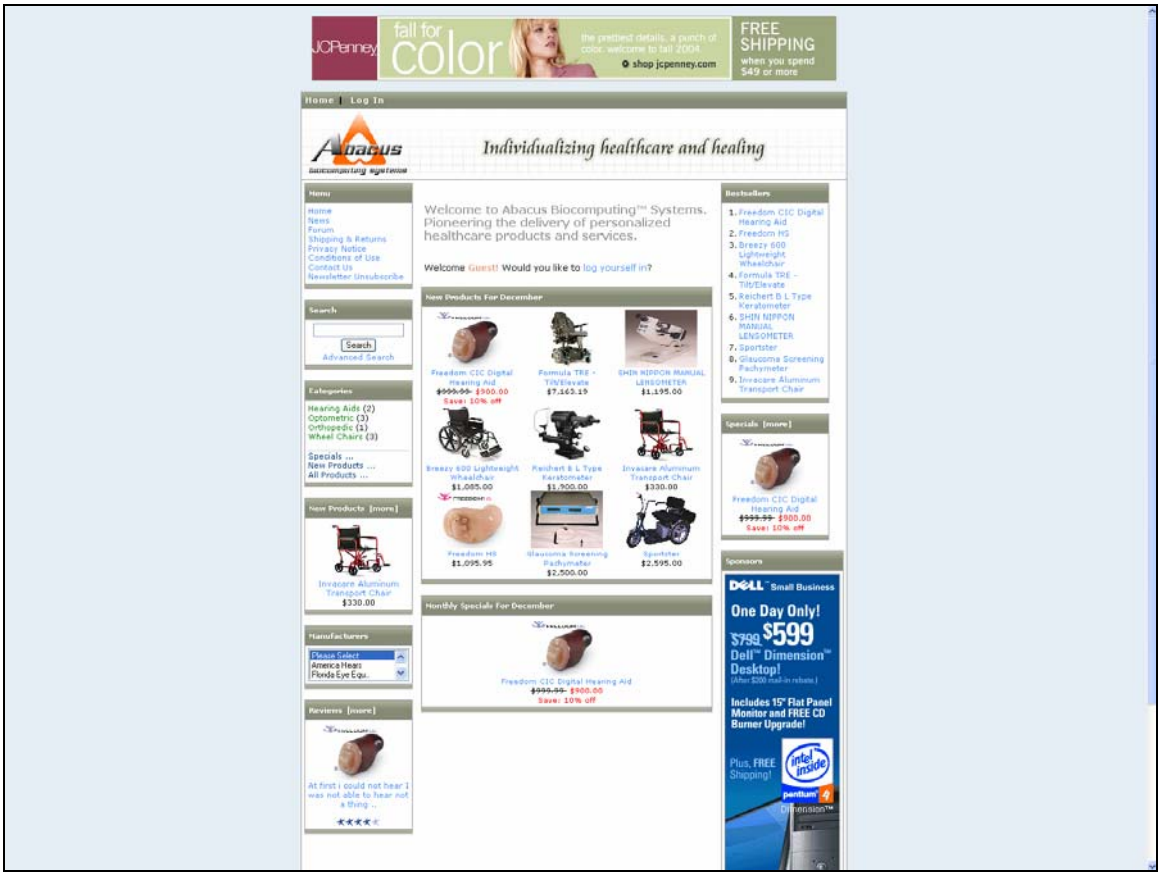


Figure 23 – Main Page

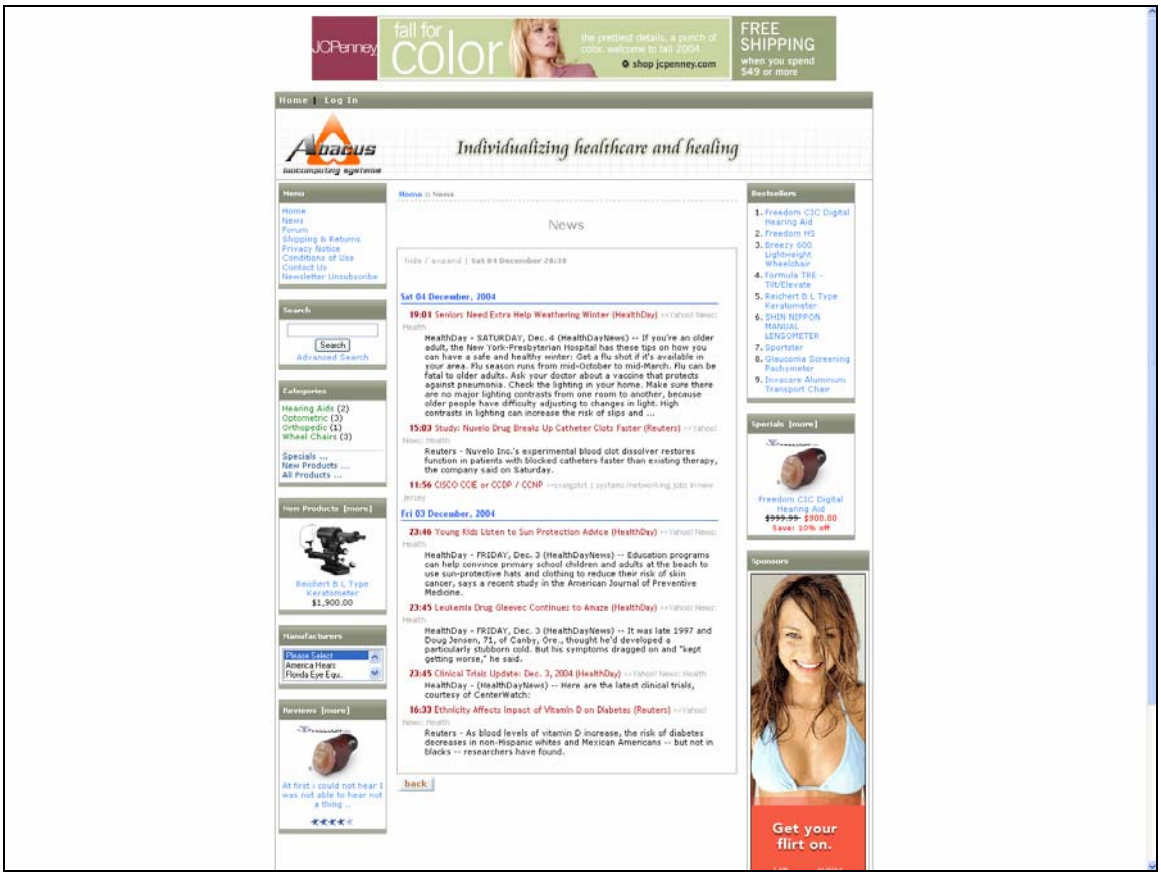


Figure 24 – News Page

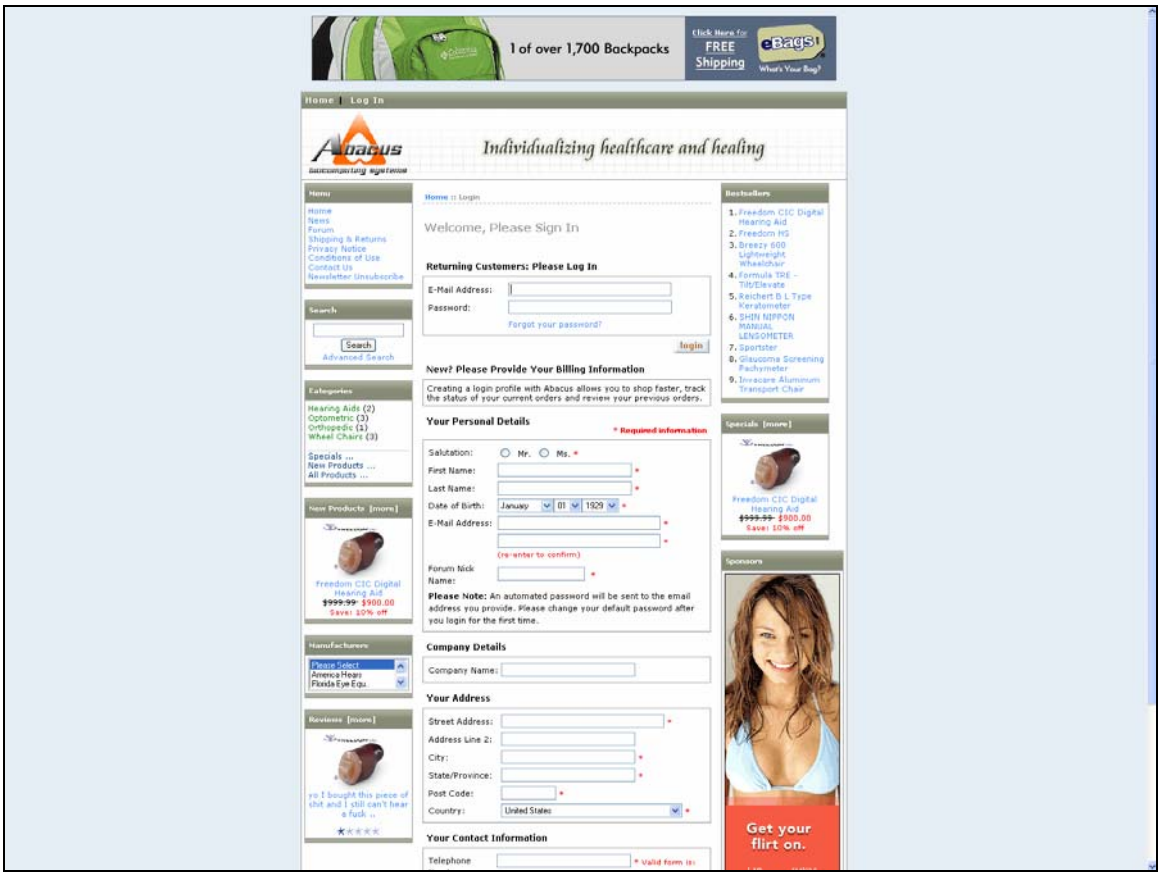


Figure 25 – Log In page

Figure 26 – Forgotten Password page

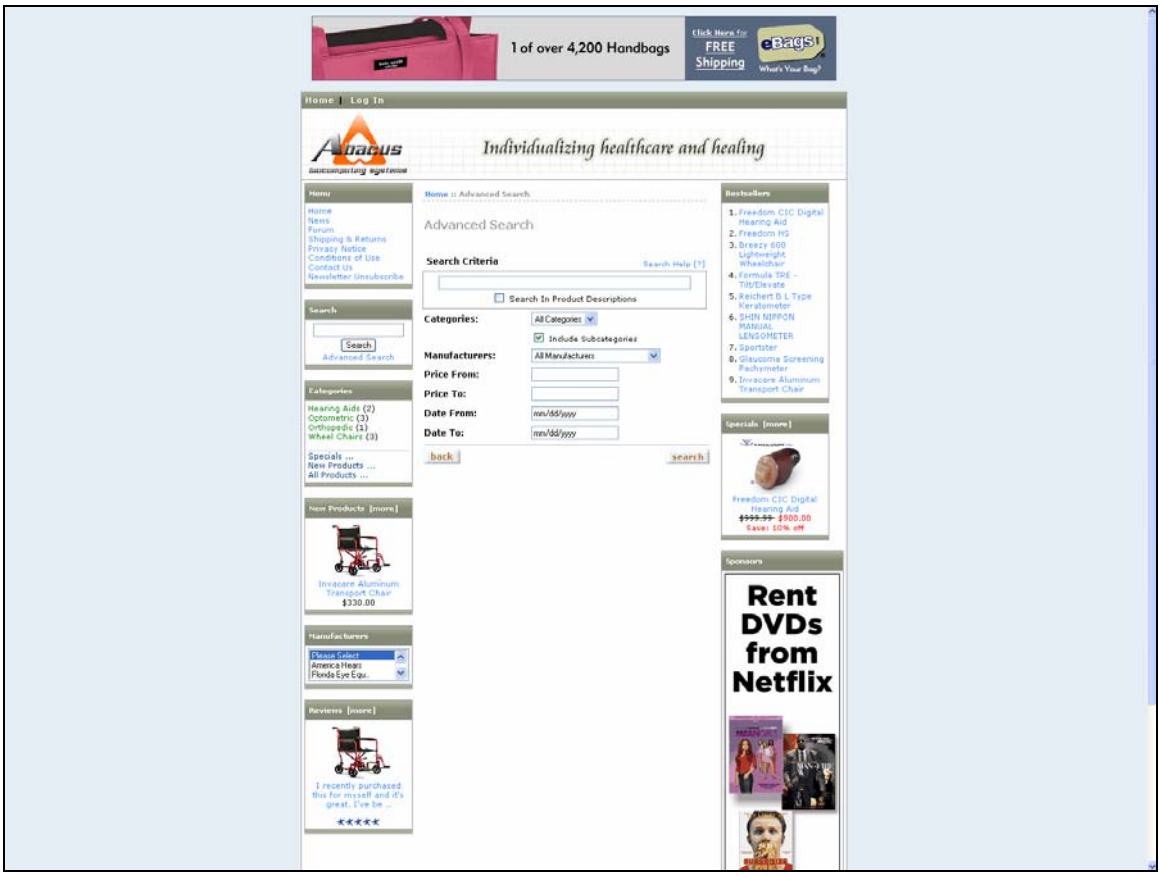


Figure 27 – Advance Search page

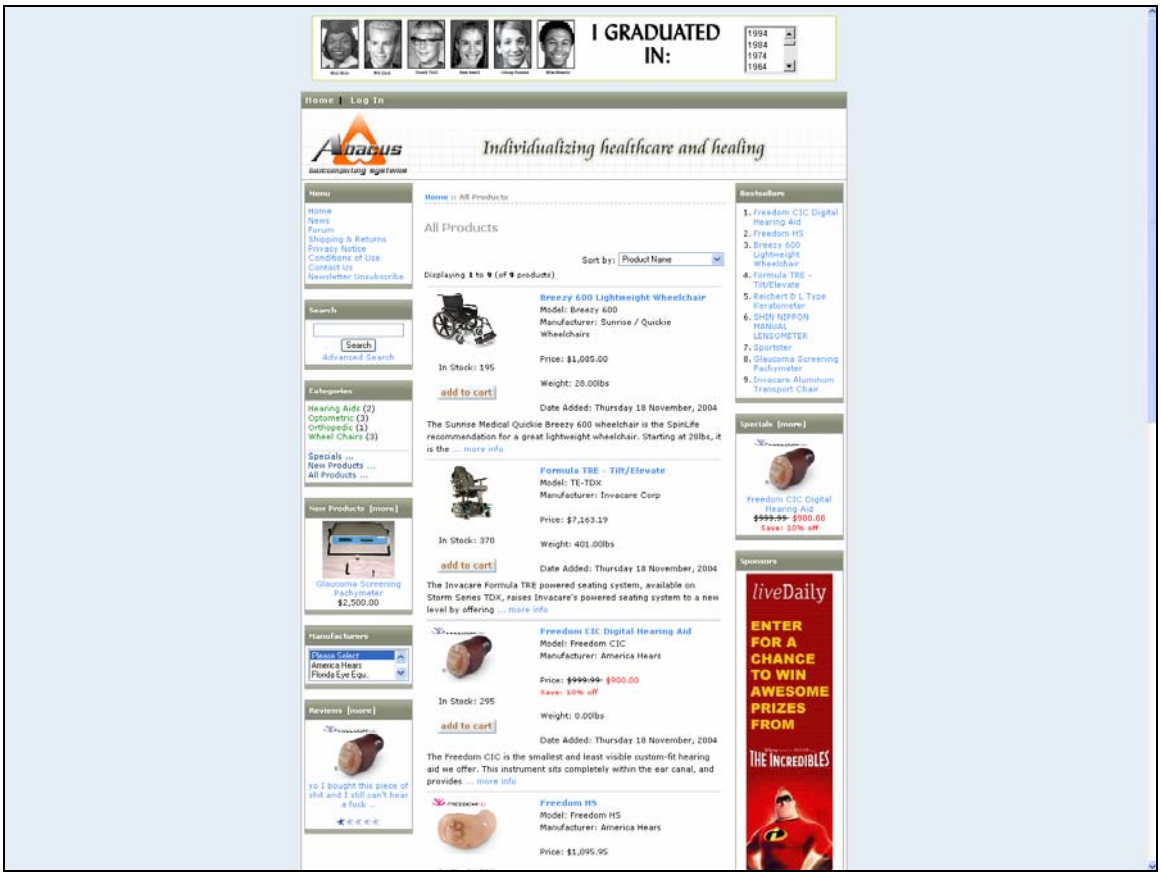


Figure 28 – All Products page

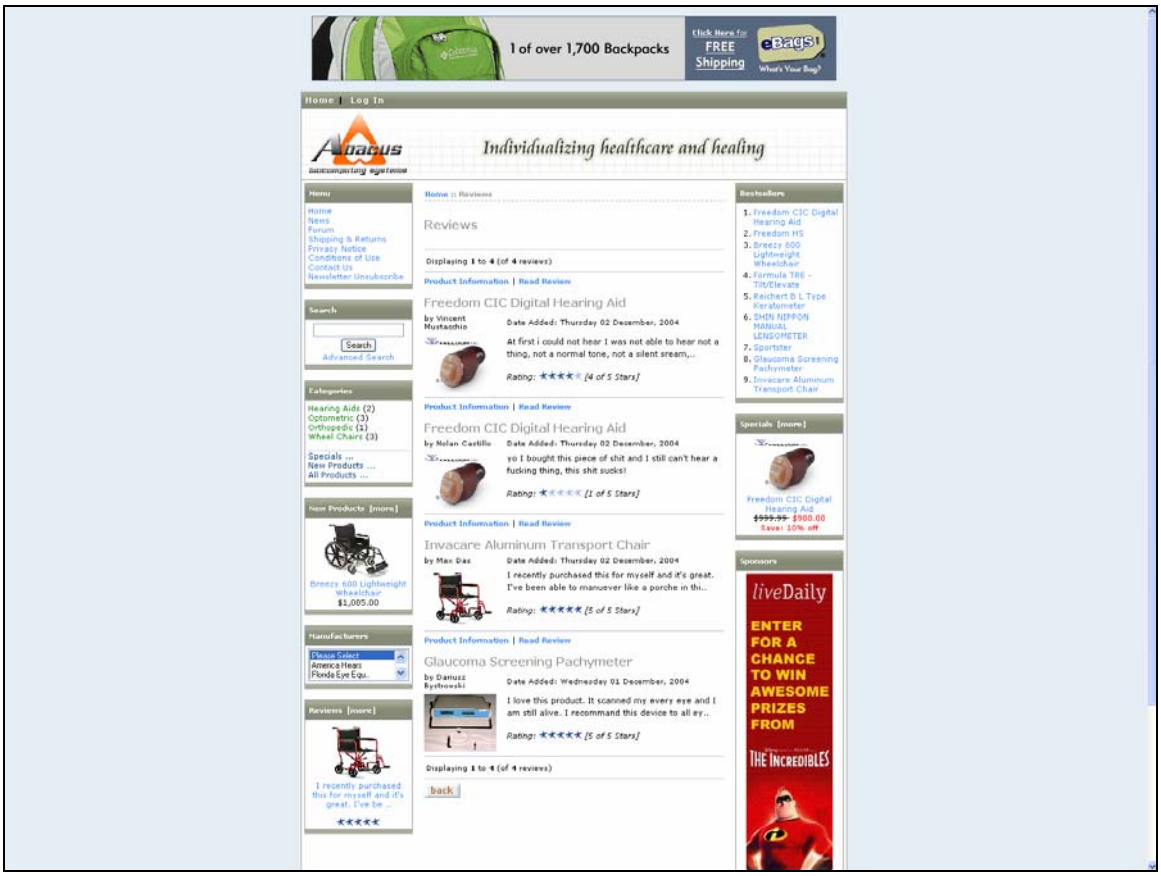


Figure 29 – Reviews page

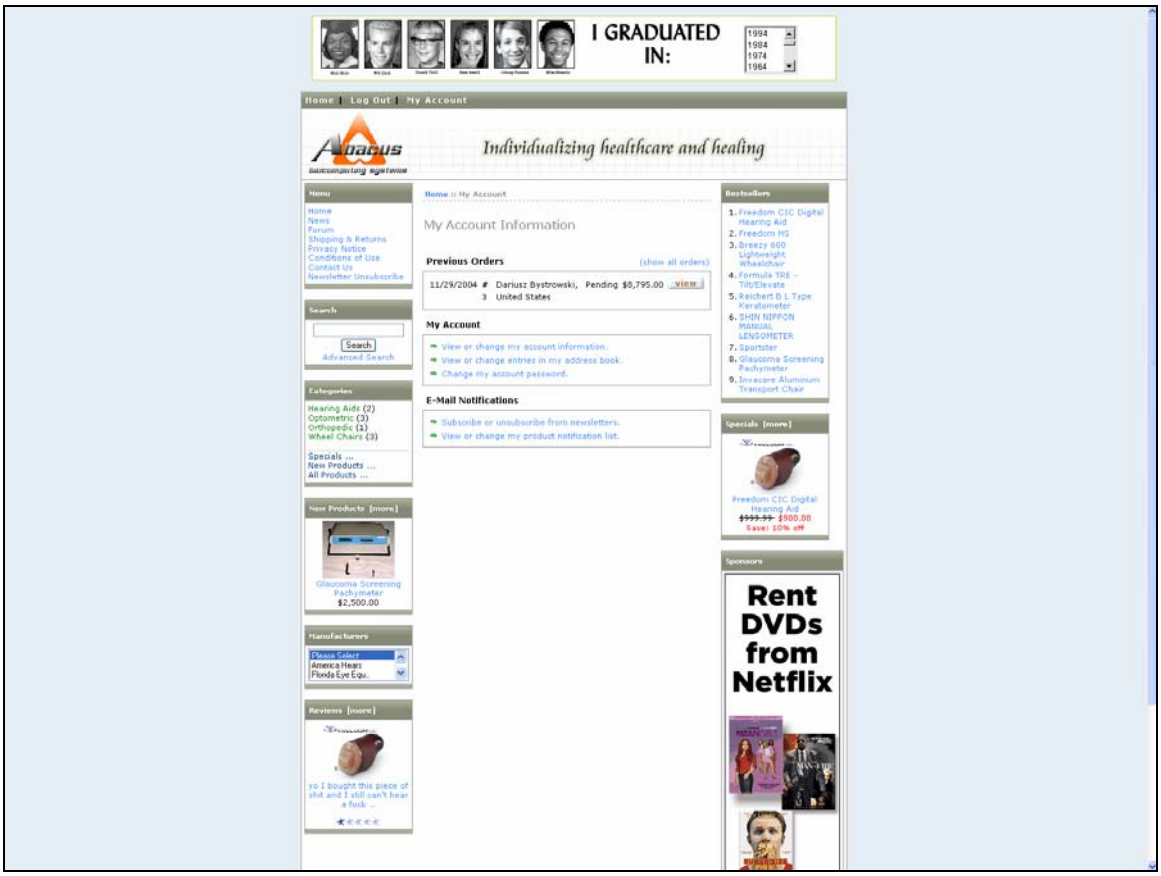


Figure 30 – My Account Information page

Figure 31 – Edit Account page

Figure 32 – Random Product page

Figure 33 – Shopping Cart page

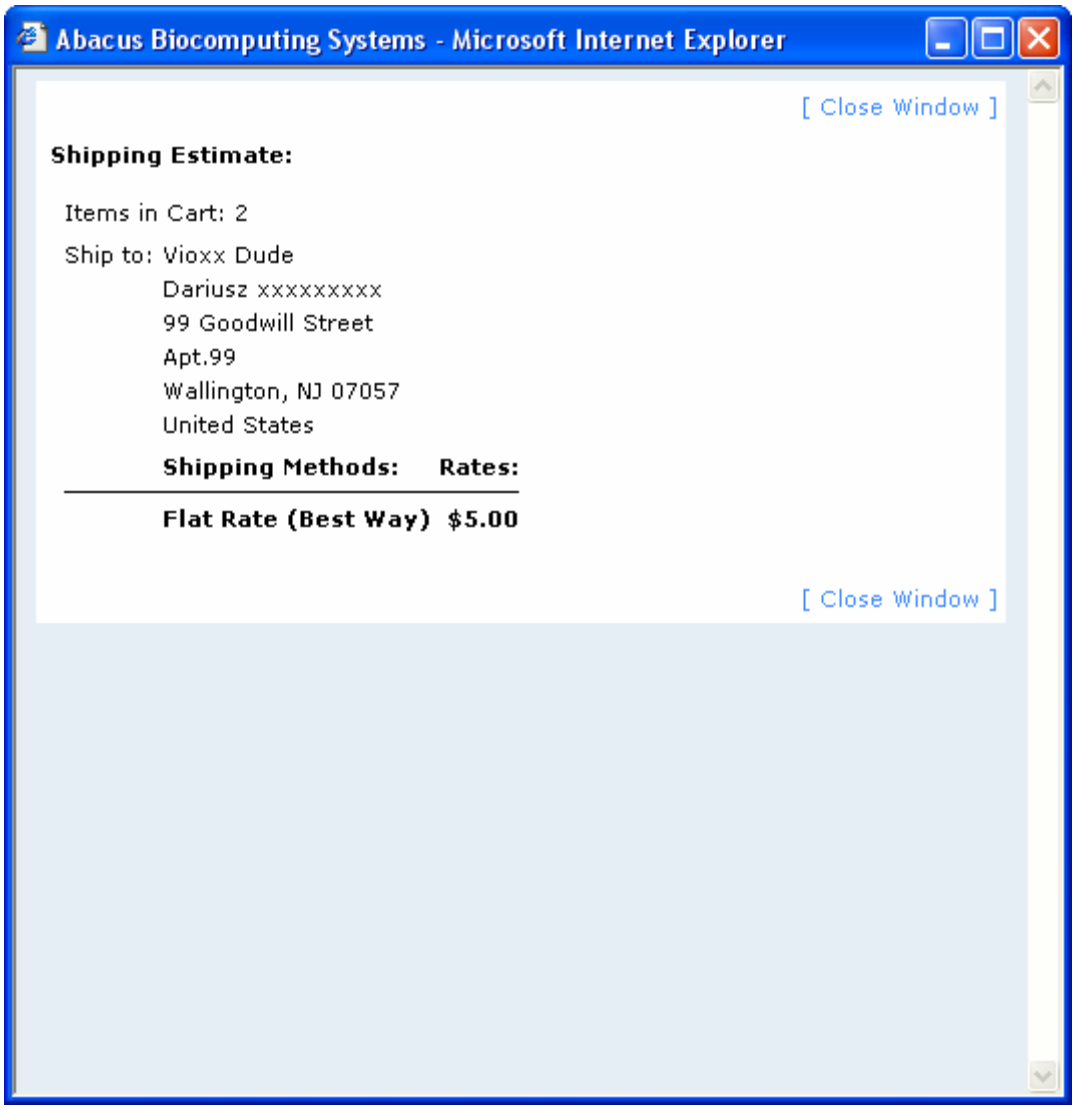


Figure 34 – Shipping Estimate pop up page

Figure 35 – Checkout process: Delivery Information page

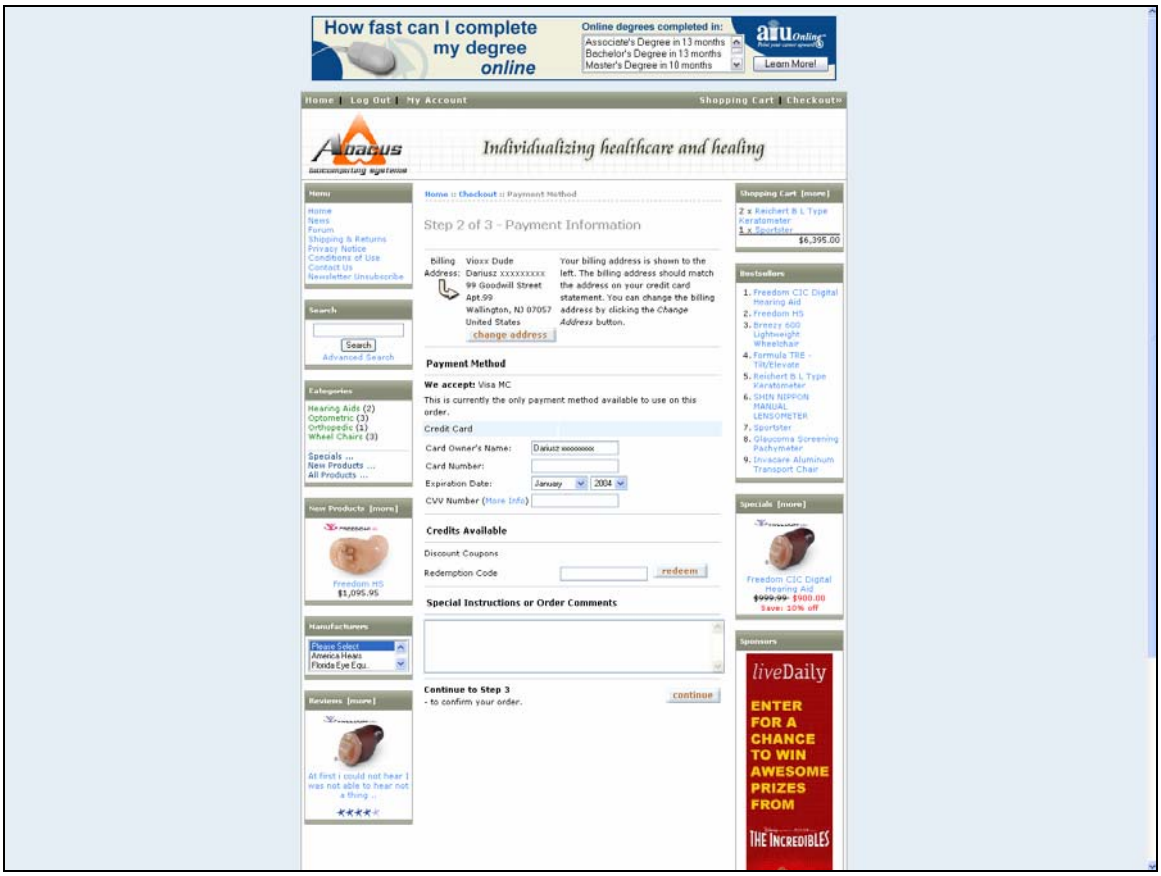


Figure 36 – Checkout process: Payment Information page

Figure 37 – Checkout process: Order Confirmation page

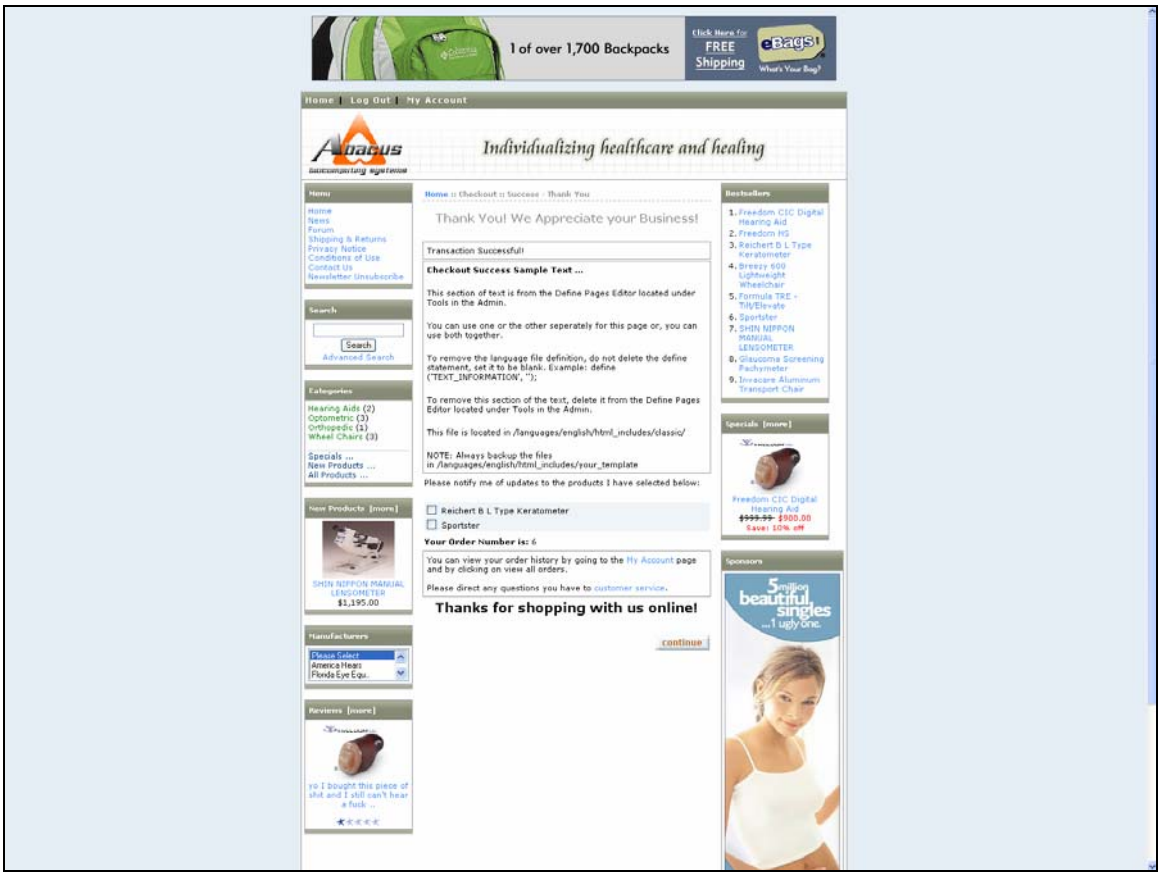


Figure 38 – Successful Order Transaction Confirmation page

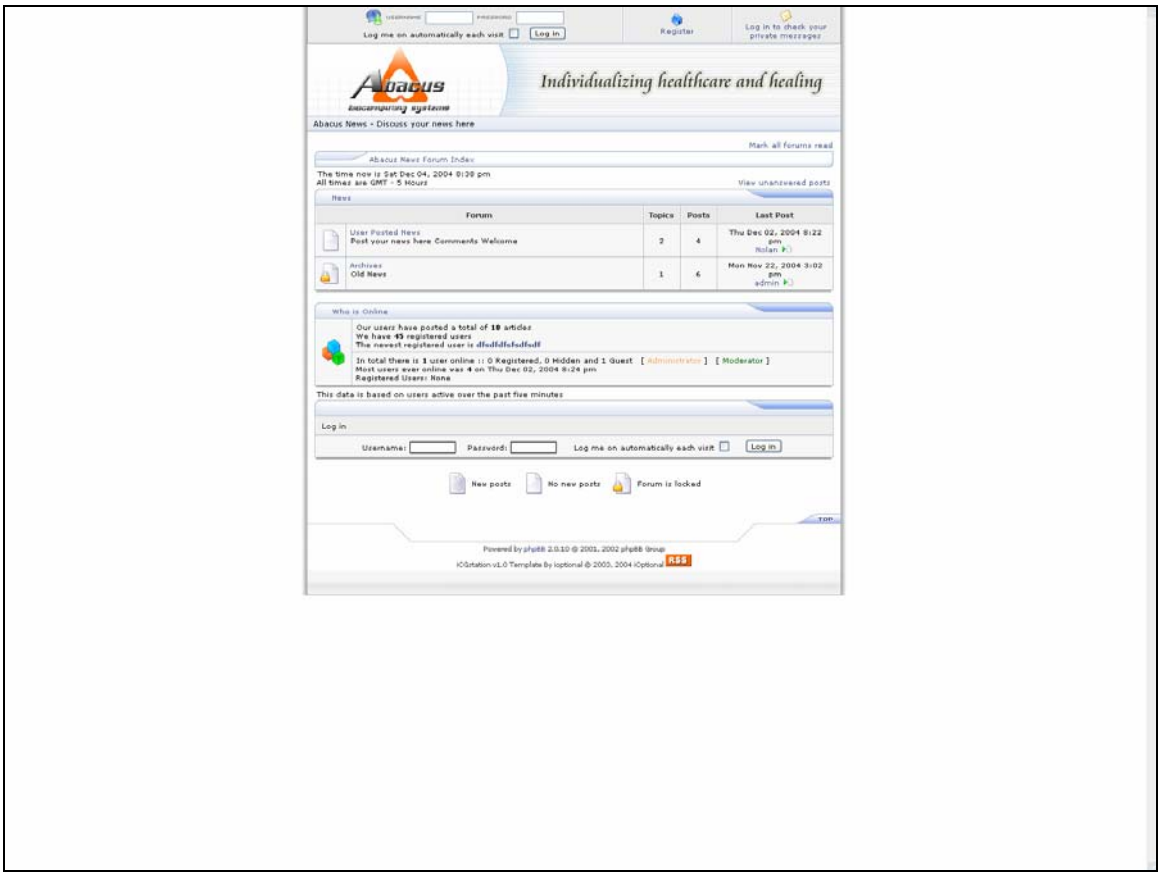


Figure 39 – Forum Page

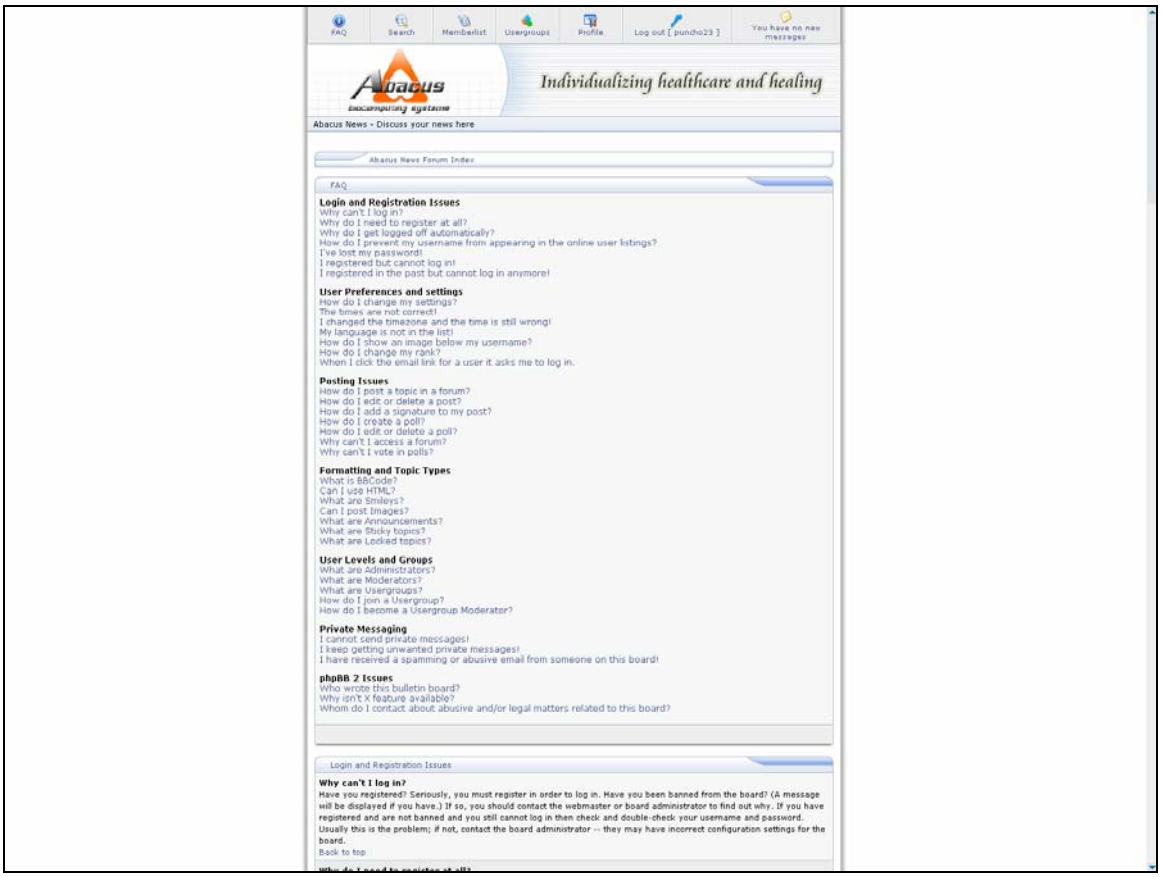


Figure 40 – Forum FAQ page

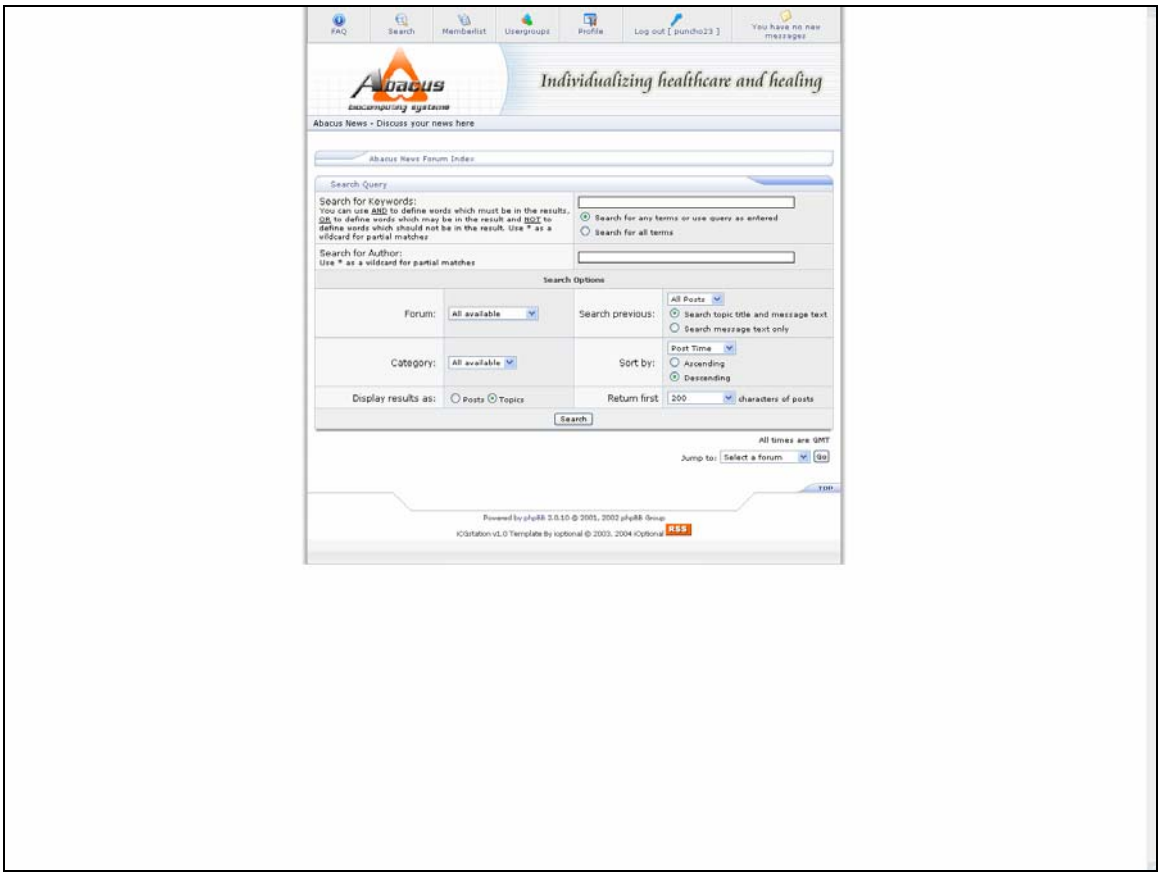


Figure 41 – Forum Search page

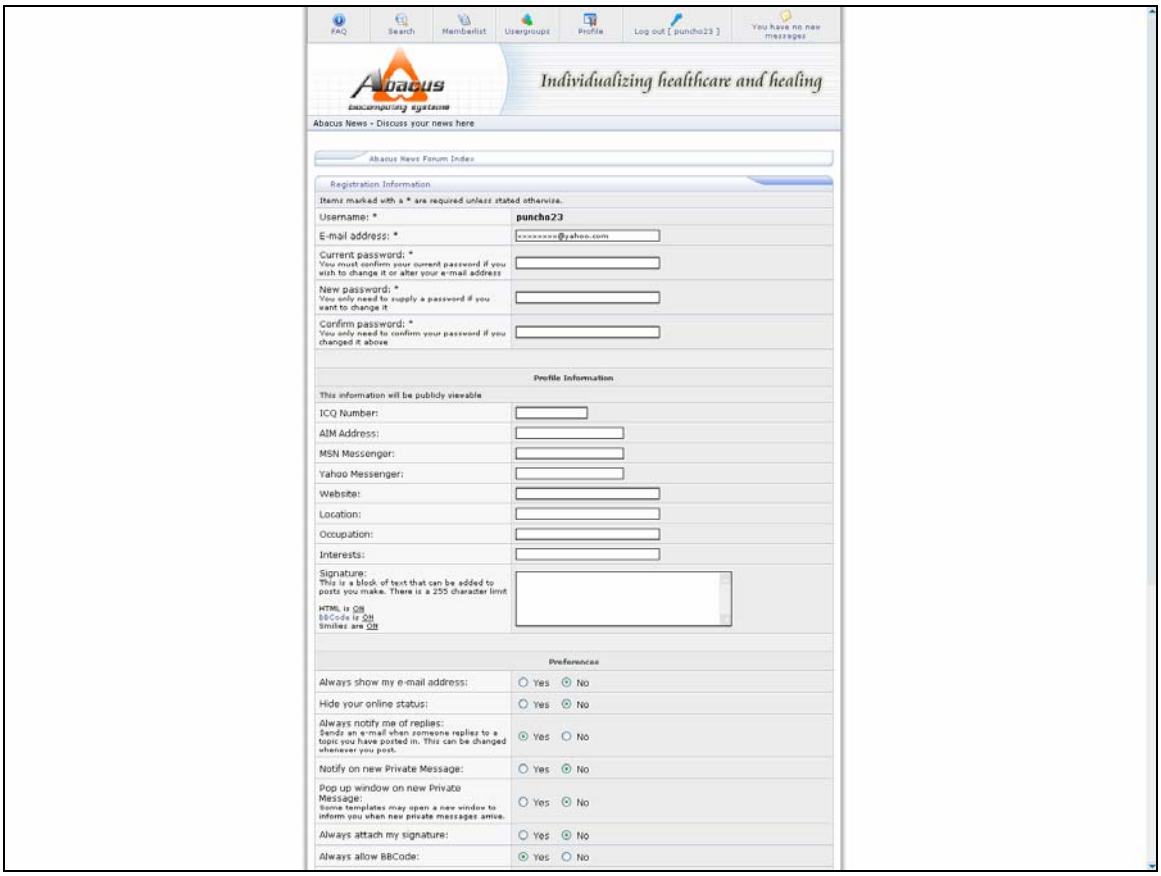


Figure 42 – Forum Member Profile page

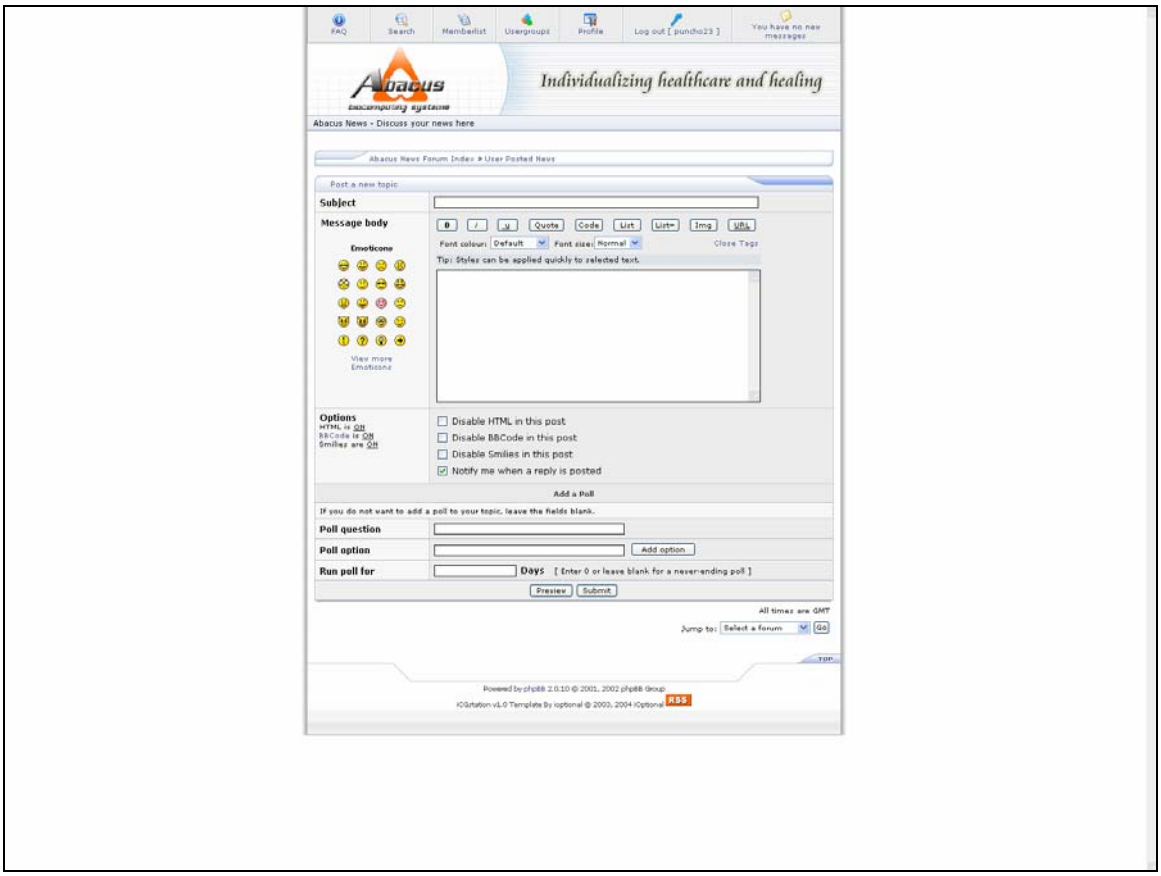


Figure 43 – Forum Thread Post page

7. REFRENCES

1. Pg 13, Waterfall Life Cycle, <http://sern.ucalgary.ca/courses/SENG/623/W02/18>
2. Pg 14, Scrum Life Cycle Model,

   <http://dotnetjunkies.com/WebLog/darrell.norton/articles/3910.aspx>
3. Pg 15, Prototyping Life Cycle Model,

   <http://www.cems.uwe.ac.uk/~tdrewry/Lifecycl.htm#Prototyping>
4. Pg 19, <http://webmd.com>
5. Pg 20, <http://www.home-medical.net/>
6. Pg 21, <http://medicinenet.com>
7. Pg 115, ACM SIGCHI, Copyright © 1992, 1996, <http://sigchi.org/cdg/cdg2.html#2_1>

8. LIST OF FIGURES AND TABLES

9. EXTRA CREDIT LIST

1. Technical Feasibility, Pg 36
2. Legal Feasibility, Pg 38
3. Admintrator’s & Developers Manual (Attached Separately)
4. Tutorial Video (On CD)