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Stock Recommender System DSS Requirements Specification

MIS 691 Term Project

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1. DSS OVERVIEW

1.1 PURPOSE

The decision being supported by this decision support system is whether to buy a particular company's stock at a given point of time or not. The motivation behind this decision was to help a novice investor, who has very little or no knowledge of financial reports and how the stock market is affected by a company's financial health, make an informed decision based on that company's financial situation. The purpose of this DSS is to design a recommender system that will consider any particular company's past and current financial information to determine that organization's health in order to make an informed decision regarding buying its stock.

This DSS will also prevent the user from making a premature uninformed decision and will help reduce biases. It will also provide recommendation and guidance by asserting control over multiple source data. This DSS is expected to extend the user's capacity to process information from multiple data sources and avoid doing time-consuming analysis for the decision, thus saving time for the user.

1.2 DESIGN ENVIRONMENT

This DSS will most likely be used in the environment of uncertainty with a certain amount of financial risk involved. Unlike the environment of certainty, in this case, more than one type of development can take place affecting the decision either favorably or adversely. The decision maker is in most cases completely in dark regarding the events that might occur. The decision maker might not even be in a position to assign the probabilities of happenings of certain scenarios and their timelines. A company's financial health and its stock price is dependent on several internal and external factors that the user in our case cannot control, thus the environment and the decision, both entail a lot of uncertainty. Since money is directly involved in this decision, it also entails a certain amount of financial risk, depending on an individual's capacity of risk capital.

1.3 USER

We expect a wide range of users to be benefited with the use of this DSS, but our typical user profile is that of a Young Novice Investor, who has graduated college, has a fair amount of disposable income that he/she wishes to invest to gain some extra cash, who is not married and/or has no family to support (thus all the disposable income can be used to invest and not worry about home mortgage, saving for down payment, kids' college funds etc.) and who is not an expert in stock market/finance. Sketched below is a typical user profile,

- Age 25 - 34 years
- Education – College degree or more (bachelors or master's degree)
- Median annual income range - \$40,000 - \$60,000

- Disposable income/ Risk capital - \$500 - \$10,000
- Novice self-investors
- Investment term – 0-5 years

1.4 APPROACH

The decision model used in this DSS is the Analytic Hierarchy Process (AHP) which is a multi-criteria decision-making approach. The AHP has a wide range of use due to its mathematical approach method and the fact that the required input data are rather easy to obtain. The AHP is a decision support tool which can be used to solve complex decision problems. It uses a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives. The pertinent data are derived by assigning weights of importance of the decision criteria, and the relative performance measures of the alternatives in terms of each individual decision criterion.

The decision philosophy used for this DSS is that of *Optimizing* which involves adopting a strategy to select the best possible solution from the available options. Optimizing is concerned with identifying the best decision to take, assuming an ideal decision maker who is fully informed, able to compute with perfect accuracy, and fully rational. The practical application of optimizing is called decision analysis, and is aimed at finding tools, methodologies and software to help people make better decisions.

For this DSS, the structure or ontology used is explained by following sequence of operations:

User info--> determines user risk level (creates a taxonomy of risk level) --> user choice of company (another taxonomy of companies) --> analysis of company using company ratio (taxonomy of ratios used) --> supporting graphs --> recommendation (taxonomy of recommendations made by DSS).

As stated below, different class of taxonomy are seen at different stages or operation points^{v,vi},

- If DSS is divided based on Daniel Power's taxonomy using mode of assistance as criterion, the model is a data-driven model. It relies on company's financial ratios to make a decision. It will access and analyze time series data to inform and recommend a user about a possible stock investment.
- Using mode of assistance as criterion, the user types can be classified as model-driven DSS. The user is asked to provide data and parameters such as user profile information, company of interest etc. to help him/her make sense of a situation and make a decision.
- Further Daniel Power's theory and use scope as criterion can be used to classify the DSS as desktop DSS as in this case it is a small-scale, single user DSS that runs on an individual mobile phone.

- Using the relationship with the user as the criterion, Haettenschweiler classifies a DSS as passive, active or cooperative. The DSS in this case falls under active category as it helps a user in decision making process by coming out with a possible suggestion or recommendation.

1.5 DESIRED OUTCOME

We will present the user with two main options for the desired outcome. The decision support system will either suggest ‘Recommend’ or ‘Do Not recommend’ buying the stock of a particular company after going through the multi-criteria weighted decision-making analysis. Since monetary risk is involved with this decision, we would like to include a third outcome which can be used if the numbers deduce that the analysis is not leaning clearly towards either recommendation, but lying in the middle grey area.

1.6 JUSTIFICATION

A managed account, in which a firm puts together and manages a portfolio for you, often requires at least \$10,000 principle. For the privilege of hiring your own personal financial adviser, you may need hundreds of thousands of dollars or more. Advisers are often paid by a percentage of the assets they manage, and a typical fee is 1 percent per year. This might get quite expensive for a person who has limited disposable income for investment. In such cases, a novice young investor is going to try and make the investing decision himself. This decision support system will help him/her make an informed decision based on all the information available to him.

This DSS is possible since the decision in question cannot be made based on common sense only, but requires some cognitive skills. For such type of decisions, genuine experts exist who can articulate their methods and agree on solutions.

This decision is justified since the task solution has a high monetary payoff and a wrong uninformed decision might cost the user dearly. Since this decision works well with expert help which is scarce (thus costly!), a DSS will play a vital role to compensate for this.

The DSS is also appropriate since the decision in question is not too easy, it has a practical value and requires use of financial rules and heuristics. Following are some of the key advantages of this DSS that will help to understand its value to the user. This DSS ⁱⁱⁱ:

- Will improve user’s chances of gaining profits on the investment
- Will allow for faster decision-making
- Will provide more evidence in support of a decision, that the user wants to make
- May increase decision-maker’s satisfaction
- Will provide different perspectives to a situation
- Will help a user to be healthy, happy, and productive

From above advantages, it can be concluded that value of the DSS is immense to a novice investor. This decision system's potential user does not have financial knowledge and is unsure which stocks to pick to get a healthy return. If the stocks are not chosen judiciously, it can cause the person to lose the money invested. As a result, this may cause mental stress, unhappiness, decline in productivity and may also cause serious illness. further, the process of choosing a particular stock is time consuming. If the decision does not generate profits or return on the investment, the time taken to make the decision is wasted. Each of these factors holds a significant value in user's decision. For example, if there is a user with following details:

The user's annual income is \$60,000.

It is further known that user works for 8 hours a day, 22 days (without weekends) every month. Using this information, user's hourly income would be:

$$\text{Hourly income} = 60,000 / 22 * 8 * 12 = \$28.41$$

Suppose, the user invests \$1000 in a particular stock.

To make this decision, user utilizes one full day of work. The user now realizes he/she has made an uninformed decision and there is a high probability, he/she would lose the money. The user is distressed and depressed and decides to get an antidepressant to relieve the tension. If we quantify this value for this investor, it would be:

- Value of DSS = money invested in stock + depression caused due to naïve decision + time taken (and wasted) to make this decision
- Value of DSS = 1000 + price of antidepressant (medicine used here is Prozac ^{iv} to be used for 30 days) +full work day
- Value of DSS = 1000 +350 + 28.41*8 = \$1406.82

Therefore, the value of DSS for a user who invests \$1000 is \$1406.82. It is to be noted that the depression and time taken may get directly proportional to amount of money invested and can substantially increase if the expected losses are high.

1.7 CONSTRAINTS/ASSUMPTIONS/DEPENDENCIES

Listed below are some of the assumptions, constraints and dependencies used while building this decision support system. It is very essential that the user is aware of these in order to know the limitations of the model.

- a) The model is also designed for companies who have publicly traded stock.
- b) This is just a recommender system that helps the user in making a decision, but not give a fool-proof decision

- c) This is not a universal DSS and several internal, external, political, economic, socio and technological factors play a huge role which can affect the company's financial health and resultantly its stock prices
- d) DSS is constrained by the knowledge input in the system
- e) It also depends on the accuracy of the information provided by the companies in their financial statement.
- f) This DSS gives its recommendations based on the established user type, thus it is assumed that the user is completely honest in answering the questions that categorizes him as a certain user type.

1.8 REVISION HISTORY

Revision	Date Modified	Author	Reason for Change
A	October 27, 2015	Team	Issued for Review and Comments
0	December 15, 2015	Team	Issue for approval

2. FUNCTIONAL REQUIREMENTS

2.1 INFRASTRUCTURE REQUIREMENTS (HARDWARE, SOFTWARE, NETWORKS)

2.1.1 Description

This DSS is a mobile application which is a standalone software running on Android and iOS systems. The Infrastructure Requirements of the application are described below,

Hardware

This application is designed for devices with,

- touch screen capabilities
- minimum of 1 GB of RAM in order to help the application run smoothly as less time will be spent on reloading applications from the internal memory.
- minimum internal memory requirement for the application is 50 MB for the device to perform without lag.

Software

The software requirements of the application are,

- IOS platform of 5 and above
- Android devices need to have an API level of 14 and above. API level is an integer value that uniquely identifies the framework API revision offered by a version of the Android platform. The Android platform provides a framework API that applications can use to interact with the underlying Android system. This translates to Android version 4.0 and above.

Networks

The device must have carrier service with proper network connectivity. This application works on client/server system concept. The client is the mobile device which contains the application interface. When the user tries to interact with the application interface, the device interfaces with a web server. The web server consists of an application which receives commands from the user's application interface. The application in the Web Server sends a command to the Database Server to perform the required operation in the Database. This database is used to store the data related to the application because if your application gets closed the in-memory data will be lost, but after that you will be able to restore the state from the database if you have one. Organizing your data in database usually makes it lot easier to manage all the application data.

2.1.2 Specific Requirements

	Requirement	Phase	RTM #
2.1.1.1	iOS 5 and above, Android 4.0 and above		
2.1.1.2	1 GB RAM		
2.1.1.3	50 MB Free Internal Memory		
2.1.1.4	Touch Screen Capability		
2.1.1.5	Mobile telecommunications connectivity at minimum 3G or Wi-Fi		
2.1.1.6	Amazon Web Services for Web Server, Oracle database for database server.		

2.2 INTERFACE REQUIREMENTS

2.2.1 Description

The user interface and display are designed for two types of mobile devices; smartphones and tablets running the required versions of Android or iOS (mentioned in section 2.1.2). The display is designed to be compatible with an adaptive UI to be suitable for a small screen in smartphone or a large screen in tablet. This application is developed for phones/tablets as users can have quick access to internet connectivity at any particular time or place. As stock prices keep changing frequently, this mobile access will enable the user to analyze his decision at any point of time. Also, we found it more prudent to have a mobile app as more users prefer mobile computing.

The interface screens have text fields for data input and touch-buttons that will lead to further processing and/or initiate the next screen (see Appendix 3.3). The user control will be through touchscreen. The user interface uses different screens. When the user opens the app the login screen will appear. Already registered users can just enter their credentials and sign in. New users will have to create an account and answer the user profile questionnaire that our system makes use of to assess the user. Once the questions are answered profile for the user is created. The already registered users can search for the companies they want to invest in. Also, the users will be able to view their previous searches of the companies. The new users will also be able to search for the company they want to invest in. When the users select the company, the results are displayed. The results displayed are based on the user profile they have created. The result would include various ratios and graphs of the company in comparison with the industry standards. Our app will "recommend or not recommend" to the user whether to invest in the stock depending on the user profile.

Calculating Results:

While calculating the results, emphasis is given to ratios which are assigned priority based on the user type. The higher priority ratios carry more weight than the ratios that have comparatively lower priority, while calculating the weighted average. The ratio result is considered positive (green tick) if it has a good score than the industry standard. Similarly, it obtains a negative mark (red cross) if it has a bad score compared to the industry standard.

Our recommender system follows a qualitative approach for calculating results rather than a quantitative one. In this case, if a company has a less number of higher priority ratios as positive and more number of lower priority ratios as negative, system will not directly reject the company but will take into account the weighted average score of the company to make this decision. Conversely, if a company has a less number of higher priority ratios as negative and more number of lower priority ratios as positive, system will not directly recommend the company but will take into account the weighted average score of the company to make this decision. Sample result tables with weighted average are attached in Appendix 3.2.

2.2.2 SPECIFIC REQUIREMENTS

	Requirement	Phase	RTM #
2.2.2.1	Touch Screen		
2.2.2.2	Adaptive GUI		

2.3 DATA REQUIREMENTS

2.3.1 DESCRIPTION

The data required in this DSS includes industry ratios relating to different groups of parameters which plays an important part in taking decisions about a specific company stock. User of this DSS is a novice investor and falls in the age group of 25 – 34 and has a disposable income of \$500 - \$10,000. We need to know preference from the users relating to their requirements and expectations when they are looking to invest in a particular company. When user logs in to the mobile app, we ask them a series of questions (see section 2.5.2.1) to help us to establish the user's risk tolerance by determining the length of term of investment, expected rate of return and level of risk he/she is willing to take. The questionnaire is created in such a way that we can retrieve information about user in terms of their current and future income sources. Based on stability of income, the DSS model might consider giving a more conservative decision for unstable income user or aggressive one for stable income user. While answering the

survey questions, user is exposed to potential situations which helps the DSS decide whether the user is a low risk taker hence expects low return or high risk taker hence expects high returns. Sample calculation is shown in section 3.2 Results table.

Based on the survey questions, DSS gives preference/weightage to different ratio groups which help the user in decision whether to go ahead with the stock. They are 3 ratio groups which the DSS assigns weightage too. These groups are price, profitability and liquidity. There are different ratios in each ratio group. Price group has 3 ratios i.e. Price to Earnings ratio, Price to Sales ratio, Price to earnings by growth ratio. Profitability group has 2 ratios i.e. Returns on assets and Return on equity. Liquidity group has 3 ratios i.e. Quick ratio, Debt to Equity ratio and Asset turnover ratio. According to the user type, the DSS assigns weightage to different groups and comes up with a consolidated list for user's decision making process.

For this DSS prototype we have considered 5 Industry sectors i.e. Technology, Pharmaceutical, Banking, E-commerce and Gas and Oil. Users select the Industry sector for the company which they want to search for. All the different decision making ratios are compared to Industry standards and presented to the user. The DSS will recommend the user to go for the company stock if ratios are more than its Industry standards. User will be also shown with graphs comparing with Industry standards for better understanding. Data regarding different ratios can be obtained from websites like Morning star and Yahoo finance.

2.3.2 SPECIFIC REQUIREMENTS

	Requirement	Phase	RTM #
2.3.2.1	Data on different ratio groups		
2.3.2.2	Data on Industry standards		
2.3.2.3	Data on ratios in the specific groups		

2.4 ALGORITHMS/COMPUTATIONAL REQUIREMENTS

We will take user's personal information such as his/her age, gender investment experience etc. to understand his/her financial commitments and investment experience. The second input will be a series of questions to determine user's willingness to take risk. In final step user will provide the name of company in which user wants to invest. Here, the pre-determined financial ratios will be compared with industry standards. The final output page will display cumulative results of all above steps and make recommendation of buying the stock or not. More about each step has been discussed in rules/heuristics section. An example of evaluation process and result for e-commerce company Amazon is been calculated and shown in appendix section 3.1 and 3.2.

2.5 REQUIRED RULES/HEURISTICS

2.5.1 DESCRIPTION

- a. We will start with establishing the primary user profile with some personal information about the user such as his/her
- Age
 - Gender
 - Marital status
 - Annual income
 - Outstanding debts
 - Level of Education
 - Investment experience

This primary information will help us understand the user better such as his/her marital status will help us understand his/her financial commitments towards family, their annual income and outstanding debt will help us understand how much capital risk they are capable of handling, their education and investment experience will also show how informed they are of the risk they are willing to take.

- b. After the basic profile is set up, we ask them a series of questions (see section 2.5.2.1) to help us to establish the user's risk tolerance by determining the length of term of investment, expected rate of return and level of risk he/she is willing to take. The questions are worded in such a way that any user can understand them, regardless of their knowledge of stock market/finance, and yet at the same time the model will extract the risk tolerance information out of selected answers.
- c. Based on the answers to the questions and the weight assigned to each answer, the model will establish the user's risk tolerance level. The different user types based on risk tolerance are described in 2.5.2.2.ⁱ
- d. In the next step, we have a set of financial ratios selected. These ratios are selected out of the large number of financial ratios available because they represent the best information about the company from an investor's point of view. Section 2.5.2.3 gives further information about the ratios.
- e. In the next step, based on the user's risk tolerance level, the model assigns weights to the above ratios. Assignment of weights varies as per the user's risk tolerance (the user type determined in 2.5.2.2) so that he/she take the risk as per their comfort level.
- f. In the last step, the selected company's (whose stock the user wishes to invest in) ratios are compared with its industry standards established by several sources such as,
- (1) Dun and Bradstreet publishes an annual called Industry Norms and Key Business Ratios
 - (2) Prentice Hall publishes the Almanac of Business and Industrial Financial Ratios

This will help the user understand how its company is performing as compared to its competitors and in general the industry standards. Section 2.5.2.4 gives some sample ratios for some industries

- g. The results page will then display the cumulative results of all above steps. (company's ratios, assigned weights as per user profile and compared to its industry standards)

2.5.2 SPECIFIC REQUIREMENTS

2.5.2.1 Questionnaire to establish user type/risk tolerance

A. How long would you like to invest?

1)	Less than 6 months	Short term
2)	6 months to 5 years	Medium term
3)	5 years or more	Long term

B. What are you most concerned about?

1)	My investment losing value	Low risk
2)	Equally concerned about my investment losing or gaining value	Medium risk
3)	Most concerned about my investment gaining value	High risk

C. Imagine that in the past three months, the overall stock market lost 25% of its value. An individual stock investment you own also lost 25% of its value. What would you do?

1)	Sell some/all of my shares	Low risk/low return
2)	Do nothing	Medium risk/medium return
3)	Buy more shares	High risk/high return

D. Generally, you prefer investments with little or no fluctuation in value, and you're willing to accept the lower return associated with these investments

1)	Strongly agree	Low risk/low return
2)	Somewhat agree	Medium risk/medium return
3)	Strongly disagree	High risk/high return

E. During market declines, I tend to sell portions of my riskier assets and invest the money in safer assets

1)	Strongly agree	Low risk
2)	Somewhat agree	Medium risk
3)	Strongly disagree	High risk

F. Given below are the greatest 1-year loss and the highest 1-year gain on 3 different hypothetical investments of \$10,000. Given the potential gain or loss in any 1 year, I would invest my money in:

1)	A (loss of \$164, gain of \$593)	Low risk/low return
2)	B (loss of \$1,020, gain of \$1,921)	Medium risk/medium return
3)	C (loss of \$3,639, gain of \$4,229)	High risk/high return

G. When it comes to investing in stock, you would describe yourself as . . .

1)	Inexperienced	May tell how much they value the decision.
2)	Somewhat experienced	
3)	Very experienced	

H. Your current and future income sources are:

1)	Unstable	Depending on the stability of income and taking into account the user type, the model might consider giving a more conservative decision for unstable income user or aggressive one for stable income user
2)	Somewhat stable	
3)	Very stable	

2.5.2.2 The Five Investment Risk Categoriesⁱⁱ

(a) Conservative

- Not willing to tolerate "any downside market fluctuations"
- Willing to forego all significant upside potential, in exchange of salvaging whatever remains
- Most likely depending on their investments to give them a retirement paycheck
- Some are on tight budgets and are barely making a living as it is, so they are very afraid of losing what little money they have left.

(b) Moderately conservative

- Adverse to "large short-term downside fluctuations"

- Typical investor in this category is either retired and getting their paycheck from portfolio income, soon to be retired, or has been burned by poor investment management and has lost money in the past
- Want to be protected somewhat from large downside market fluctuations
- Their investment will still fall when the markets' decline, but they want to be somewhat protected from sudden double-digit percentage declines in their value

(c) Moderate

- Desire to invest long-term for retirement or college funding
- Want good returns, and know they're taking some risk
- Their portfolio should go up less than the markets as a whole, but should also go down less when markets go down
- Aim is to reduce risk and increase profits
- Balance between profits and loss reduction is the goal
- They know they will lose money if the markets go down, but also expect to be along for the ride if they go up.

(d) Moderately aggressive

- Wants to outperform a basket of similarly weighted indices when the markets are up, and doesn't mind being down a little more than the markets when they are down
- Taking on more downside risk than the markets, but expect to be substantially ahead of the game when markets go up
- Take the risks of winning the game by playing hard offense, but still don't want to lose too much in a short period of time
- Want to accumulate a significant amount of wealth in the future, are willing to wait a significant amount of time for the rewards (and to recoup short-term losses)

(e) Aggressive

- want to substantially outperform the markets and (should) know they are exposed to much more risk than the markets
- are typically younger and intend to contribute relatively large amounts into the portfolio periodically over time via contributions coming from earned-income
- Willing to easily lose up to 40% of their portfolio value in a few months, and it may take years, if ever, to recoup these losses
- Either want to accumulate substantial wealth in the future, are in a hurry, have enough income from other sources to fund their living expenses, and/or have plenty of time to work and recoup losses
- Should know they would lose a very high percentage of their money if the markets go down, but also expect to profit greatly if they go up

2.5.2.3 Financial Ratios

In order to understand a company's health from an investor's perspective, we selected these top 8 financial ratios and analyzed them in a multi-criteria decision model.

- i. Earnings per share (EPS): The portion of a company's profit allocated to each outstanding share of common stock. Earnings per share serves as an indicator of a company's profitability.
- ii. Price/earnings ratio (P/E): P/E Ratio is equal to price per share / earnings per share. Price-to-earnings ratio is the price one will pay for \$1 of earnings. A general rule of thumb is that shares trading at a "low" P/E are a value, though the definition of "low" varies from industry to industry.
- iii. Stock's price/sales ratio (P/S ratio): P/S ratio is price per share / annual sales per share. P/S is the price paid for \$1 of sales.
- iv. Debt to Equity Ratio: This ratio is equal to total liabilities / total shareholder equity. The debt-to-equity ratio measures the relationship between the amount of capital that has been borrowed (i.e. debt) and the amount of capital contributed by shareholders (i.e. equity).
- v. Asset Turnover: This is equivalent to sales / average total assets. The asset turnover ratio tells an investor how good the company is at using its assets to make products to sell.
- vi. Quick Ratio: Quick ratio gives a value for (Current Assets - Inventory) / Current Liabilities. The quick ratio (also known as the acid-test ratio) is similar to the quick ratio in that it's a measure of how well a company can meet its short-term financial liabilities.
- vii. Return on Assets (ROA): It is a ratio of net income and average total assets. ROA tells how good the company is at using its assets to make money.
- viii. Return on Equity (ROE): It is a ratio of net income and average stockholder equity. ROE tells how good a company is at rewarding its shareholders for their investment.
- ix. PEG ratio: PEG ratio is equal to P/E Ratio) / projected annual growth in earnings per share. The PEG ratio is able to take into account future earnings growth. A general rule of thumb is that any PEG ratio below 1.0 is considered to be a good value.

2.5.2.4 Industry Standards

We compared the financial ratios of the company in question with its industry standards to see how the company is performing as compared to its peers. Figure below shows some examples of industry standard ratios for various industry types.

	Current Ratio	Quick Ratio	Debt to Equity	Sales to Inventory	DSO	Profit Margin %
Agriculture	1.31	0.39	1.33	2.52	19	2.58
Mining	1.19	0.77	0.48	0	52	0
Construction	1.44	0.98	1.31	4.74	43	1.74
Manufacturing						
Leather/Textile/App	1.5	0.62	1.48	6.05	34	1.64
Chem. Petrol. Metal	1.54	0.75	1.33	6.94	48	2.23
Wood Related Prod	1.43	0.62	1.41	6.46	33	2.16
Mach-trans equipment	1.54	0.74	1.34	5.89	51	2.38
Trans-Communication	1.03	0.7	1.64	0	34	1.84
Wholesale						
Non-Durable	1.53	0.66	1.7	4.63	39	1.4
Durable	1.42	0.69	1.6	7.36	31	1.11
Retail						
Hardware	1.68	0.43	1.3	4.2	22	1.11
Gen. Merchandise	2.14	0.15	0.59	3.81	4	0.16
Automobiles	1.23	0.19	2.61	4.75	9	0.84
Apparel	1.9	0.14	0.91	2.96	2	1.35
Furniture	1.61	0.38	1.33	4.03	16	0.92
Restaurants	0.73	0.18	1.24	35.65	1	0.43
Financial Services	1.18	0.34	0.72	0	1	1.29
Business Services	1.36	0.84	1.11	0	42	1.75
Service Industry	1.29	0.68	0.75	3.04	15	0.77

Figure 2.5.2.4 Example of Industry Standard Ratios for various Industries

2.5.2.5 User type and ratio weights

For each of the user type, we have determined what part of investment (risk, term of investment, expected return) has highest and least priority and assigned weights to the concerned ratios accordingly.

3 APPENDICES

3.1 DECISION MODEL

Risk Categorization

Risk Category	Price ratio weightage (%)	Profitability Ratios weightage (%)	Liquidity Ratio Weightage (%)
Low Risk	30	20	50
Medium Risk	20	50	30
High Risk	50	30	20

Investment Duration

Investment duration	Price ratios weightage (%)	Profitability ratios weightage (%)	Liquidity ratios weightage (%)
Short term	30	20	50
Medium term	20	50	30
Long term	50	30	20

Price ratios are composed of:

- i. Price to earnings
- ii. Price to earnings by growth
- iii. Price to Sales

Profitability Ratios are composed of:

- i. Return on Assets
- ii. Return on Equity

Liquidity Ratios are composed of:

- i. Quick Ratio
- ii. Debt to Equity
- iii. Asset Turnover (Efficiency ratio but classified under Liquidity since it indicates level of risk)

Evaluation:

For a customer who has X level of risk taking capability, who invests for Y amount of time the above matrix will determine the net value of his stock. Consider he invests \$10,000 having the following criteria:

- Risk = X = Low

- Duration = Y = Long term

The Model will determine whether a stock should be invested or not based on the following criteria:

- Liquidity Ratios will be given higher preference (50%) as compared to Profitability (20%) and Price ratios (30%) to cover his risk since X = Low

Liquidity Ratios will be given higher preference (50%) as compared to Profitability (20%) and Price ratios (30%) to cover his risk since X = Low

- From the stocks that match the criteria (1), for long term investment the filtered out companies will be assigned preferences in the order: Price (50%), Profitability (30%) and Liquidity (20%)

Diversified portfolio:

It is not necessary to invest entire amount in a single company. In fact, it is not even recommended. Therefore, our model allows the investor to diversify his portfolio and invest in more than one stock. For the purpose of the project we determine the top 3 companies based on Risk and Investment Duration and split the stocks in the following manner:

- Stock ranked 1 will get the investment share equal to 50% of the total amount
- Stock ranked 2 will get the investment share equal to 30% of the total amount
- Stock ranked 3 will get the investment share equal to 20% of the total amount

Hedging:

This is future scope of our project can include Hedging. A hedge is an investment to reduce the risk of adverse price movements in an asset. Hedging is targeted to balance the risks of any investor. It mitigates the risks posed by stock market fluctuations. There are several hedging strategies, that can be implemented to neutralize the risks, such as,

- Buy two stocks that are negatively correlated, so that when price of one stock falls, the other one rises, thus reducing (eliminating, in an ideal world) the losses.
- Determine when a particular company's stock price reaches rock bottom (and has reached a level where it cannot fall further). The investor then buys stocks of this companies and then waits until the stock price rises and then immediately sells the stock once the target price is reached.

3.2 Result Table

Ratio Group	Ratios	Weight by Risk	Weight by Duration	Overall Importance
Price	Price to Earnings Ratio	20%	50%	Apply 20% weightage to all companies then apply 50% to remaining companies
	Price/ Sales Ratio			
	Price to Earnings Growth Ratio			
Profitability	Earnings per Share	30%	30%	Apply 30% weightage to all companies then apply 30% to remaining companies
	Return on Assets			
	Return on Equity			
Liquidity	Quick Ratio	50%	20%	Apply 50% weightage to all companies then apply 20% to remaining companies
	Debt to Equity Ratio			
	Asset turnover Ratio			
Total		100%		

Table 3.2.1 - Calculation of results for Amazon

3.3 USER INTERFACE



Screen 1

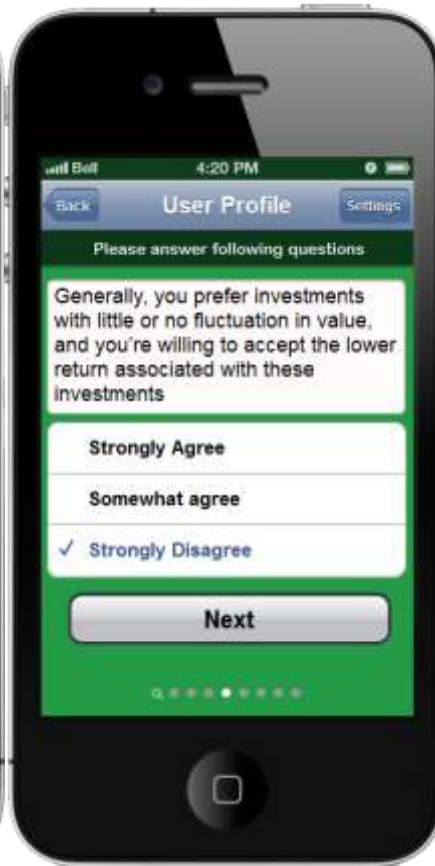
Screen 2

Screen 3

In the figures above, you can see the initial screen in Screen 1. Screen 2 and 3 show the questionnaires that the user is supposed to answer in order to establish is user type



Screen 4



Screen 5



Screen 6

The questionnaire continues on Screen 4,5 and 6



Screen 7

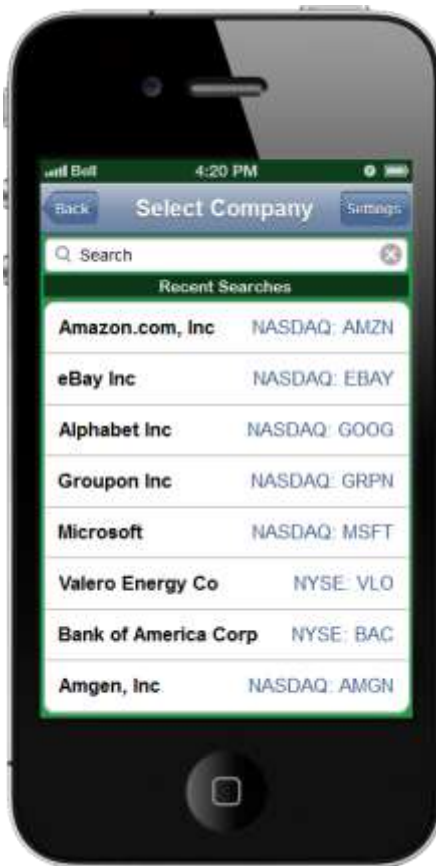


Screen 8

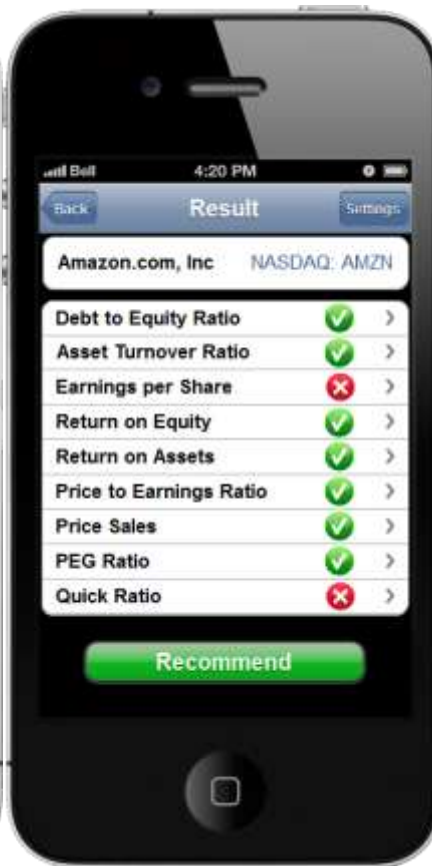


Screen 9

The questionnaire continues on Screen 7,8 and 9



Screen 10



Screen 11



Screen 12

On Screen 10, the user can search for the company he/she wishes to analyze. Screens 11 and 12 show sample results of the search.

References

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- ⁱ <https://personal.vanguard.com/us/FundsInvQuestionnaire>
 - ⁱⁱ http://www.toolsformoney.com/investment_risk_tolerance.htm
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