I. About Wildcatter (v0.3)

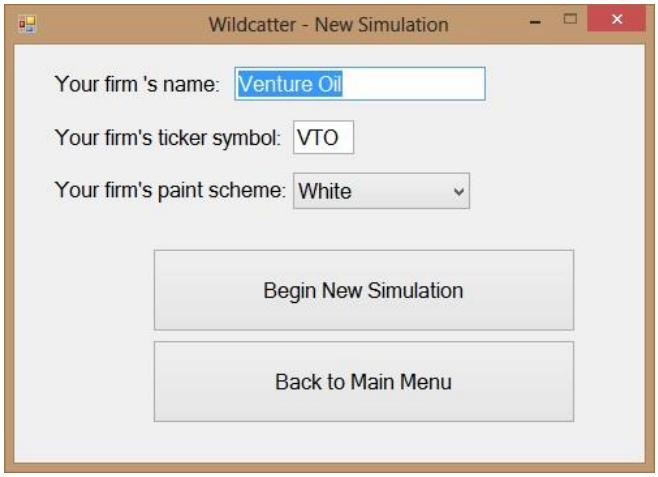
Wildcatter is an energy finance simulation developed and programmed by Matthew Blazewicz as part of an independent study under Dr. Betty Simkins of Oklahoma State University Spears School of Business. The simulation allows the user to take control of an upstream energy company, making business decisions and competing with computer controlled businesses in a simulated energy industry. The simulation incorporates accounting, finance, and economic concepts to provide feedback based on the user's decisions.

II. The Main Menu and Beginning a New Simulation

On starting Wildcatter the Main Menu is displayed. From there the user may begin a new simulation or quit the current simulation. The load simulation feature is not currently enabled, and may be added in a later software release.

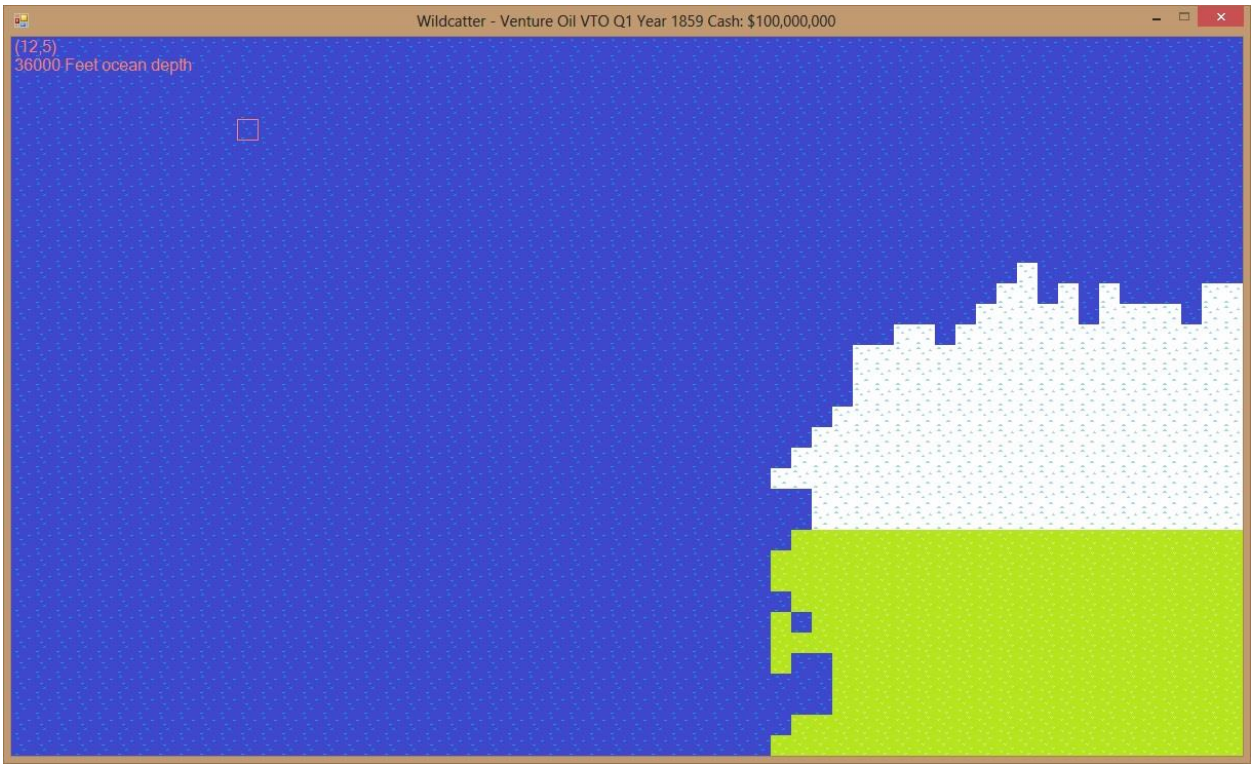
Main menu window.

Once the user selects a new simulation a new window is displayed which allows the user to name their firm and select a stock ticker and the firm's paint scheme. Clicking on the "begin simulation" button displays the main simulation interface.



New simulation window.

II. The Simulation Interface



Main interface map.

The simulation takes place on a map of tiles, each representing an area that may be explored and developed. The map is sized to 360x180, but the simulation interface only displays a 60x35 portion of the world. The mouse cursor is represented by a tile sized box, its location always displayed in the upper left hand corner of the simulation window in typical coordinate fashion: (x, y). To view the rest of the map, move the box cursor to the map's edges. Once the cursor is on an edge (and the edge is not a map boundary), the map will begin scrolling in that direction one tile space at a time. Clicking on the edges jumps the map ten tiles in the scrolling direction. Initially the simulation interface displays the most Northwest corner of the map.

The map is randomly generated at the beginning of each simulation, and is made up of five types of tiles, reach representing different types of geography and climate:

1. *Ocean or lake.* Oceans and lakes are blue, and have varying depths. The varying depths are a factor in determining costs, once the firm engages in offshore drilling. As a firm invests in more advanced technology, it may drill in deeper waters. Oceans are prone to storms and hurricanes, both of which can affect operating costs for a firm.
2. *Temperate.* These regions are represented by green grass squares, and are the least prone to weather effects.

3. *Desert.* These hot regions are prone to sandstorms, and are represented by tan tiles covered in cacti. Sandstorms also affect operating costs in these regions. Desert regions are located near the map's equator, midway between the northern and southern edges of the world.
4. *Arctic.* The arctic regions are represented by white tiles, and can only be operated in when a firm has the most advanced technology. They represent the most challenging environments for energy development.
5. *Cities.* Cities tiles are represented by a series of skyscrapers and other buildings, and are the only tiles on which research projects may be conducted. Consignment fees throughout the game are determined by a tiles proximity to a city, the closer a project is, the more expensive the consignment fee.

The main interface map window also has a title bar at the top displaying the user's firm name, stock ticker, and cash holdings, as well as the current quarter and year in the simulation.
Another way to move about the world map is by using the minimap. To toggle the minimap on or off, press the spacebar. The minimap appears in the upper left most corner of the simulation, with a box representing the current section of the world being displayed on the main interface. Clicking a location on the minimap jumps the main interface to the clicked minimap location.

Main interface map with minimap displayed.

To help keep track of explored areas, there is also a reserves overlay map. Press "R" on the keyboard to toggle the reserves overlay map. The reserves overlay map displays empty orange boxes where conditions are favorable for exploration, orange tiles where exploration has been unsuccessful, yellow

tiles where reserves have been found that are not currently feasible, and pink tiles where feasible reserves exist. The reserve overlay map populates on the minimap and main interface map.

Main interface map, minimap, and reserve overlay map. Notice the empty orange boxes representing areas with favorable conditions for deposits. After exploring, the boxes fill in with orange, yellow or pink tiles. Orange indicates no reserves yet found, yellow indicates reserves found that are not currently feasible, and pink indicates feasible reserves found. Unfeasible areas may become feasible later on with the advancement of technology, allowing for shale extraction and deeper drilling.

III. Simulation Turns

The simulation takes place over a series of turns, each representing one quarter of operations. When a turn is ended the projects in the user's portfolio execute their operations and expense any costs. These costs are then aggregated to produce consolidated financial statements. Upon ending a turn messages from ongoing projects are also displayed.

The user's project portfolio is a series of energy projects represented on the main interface map by animated project sprites. The project sprites are **not** representative of the firm's current technology level, they are merely placeholders for project locations (obviously seismic trucks did not exist in 1859). Projects available are the following:

1. *Exploration*.  These projects are represented onshore by seismic trucks and offshore by exploration vessels. Exploration projects are necessary to find oil reserves for development. In

this simulation, exploration projects include surface and subsurface analysis, and exclude any exploratory drilling.

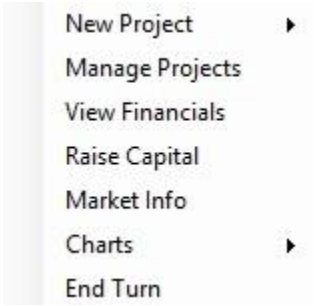
2. *Development*.  These projects should be initiated on tiles where exploration projects have reported feasible reserves. They are represented by onshore by a drilling derrick and offshore by a drilling platform. Development projects include the drilling of an exploratory well, as well as a feasibility assessment once a reservoir has been reached.
3. *Production*.  These projects should be initiated on tiles where development projects have completed exploratory wells, and represent the simulations sole source of revenue. Any oil or gas produced is from these projects is sold at the market price. These projects are represented onshore by a "nodding donkey" and offshore by a SPAR platform.

IV. Creating Projects

As previously mentioned, the firm's success is contingent on maintaining positive cash flows from a portfolio of energy projects. To create a project, right click on the tile where you wish to locate your project. This brings up the main interface menu.

Exploration Projects 

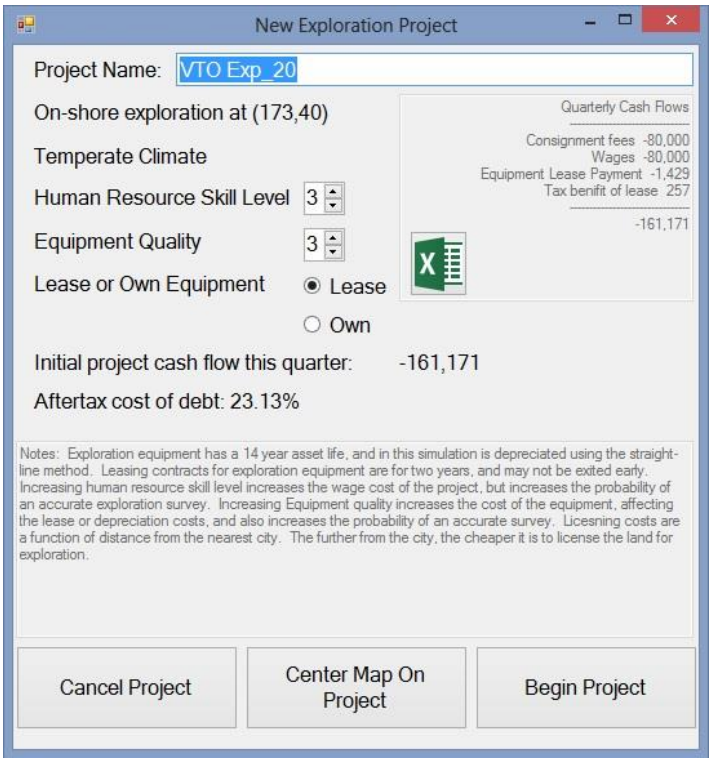
Initially it is important to create exploration projects to find feasible reserves in order to establish a revenue stream. To create an exploration project, right click on the area you wish to explore. At first only desert and temperate tiles will be available, artic and offshore exploration can only be conducted once the proper technology has been discovered. After right clicking, the main interface menu is displayed. Select New Project->Exploration.



Main interface menu (right click).

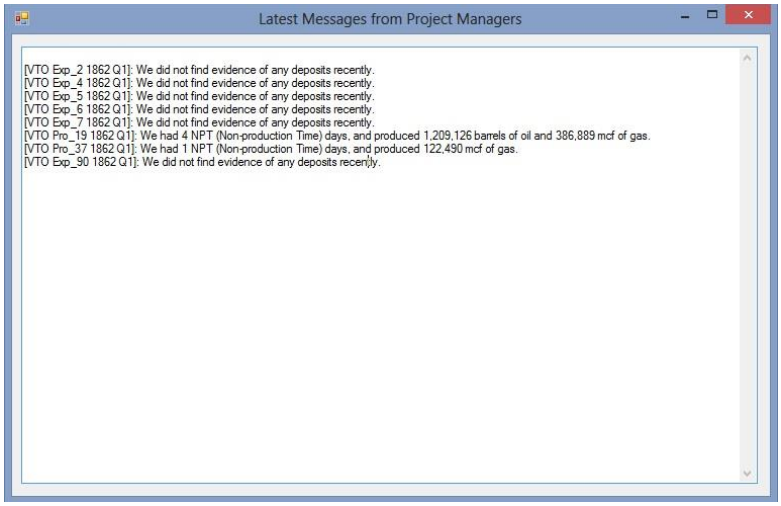
This brings up the New Exploration project window. From here human resources and equipment quality levels can be set. Higher quality incurs higher labor and equipment costs, but also may increases the chance of discovering oil and gas deposits. A dynamic estimation of cash flows is visible on the right hand side of window. Exploration projects may be leased or owned, and the project window displays the after tax cost of debt should the user desire to conduct a discounted cash flow analysis of a lease vs. a purchase. Leasing allows the user to deduct the lease payment as an expense, thus reducing taxable income. Owning a project allows the user to deduct depreciation as an expense. Exploration projects

have a depreciable asset life of 14 years. Once variables are set, select begin project, and a seismic truck will begin work in appropriate tile. Costs will not be applied until the turn is ended.



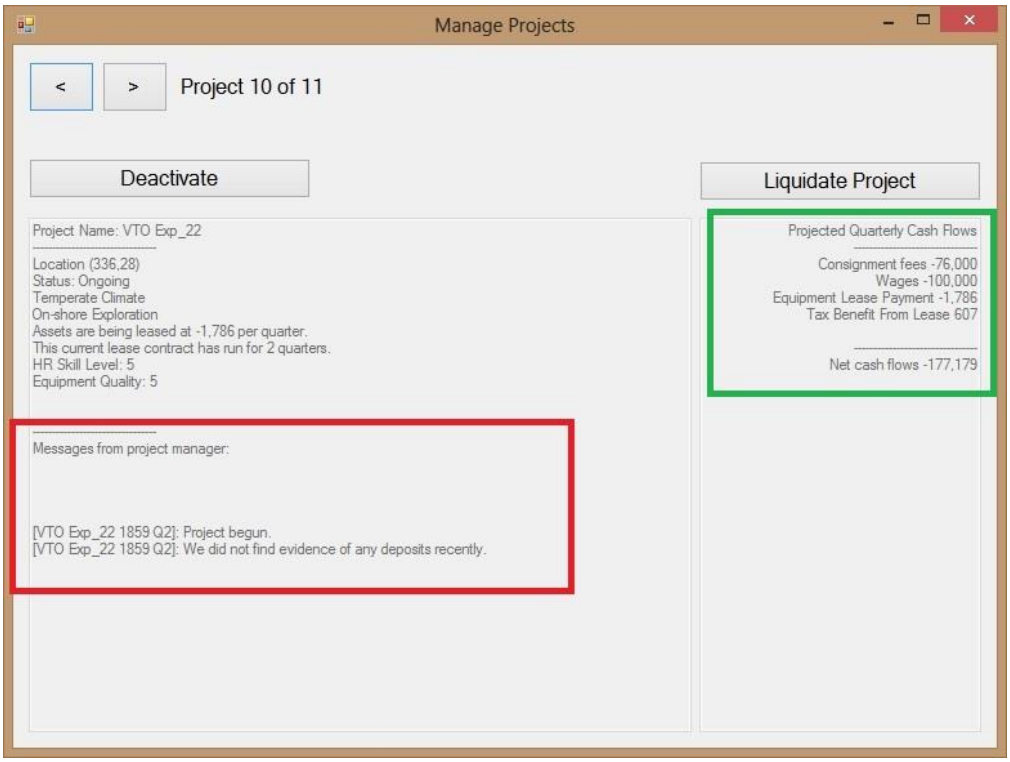
New exploration project window.

After ending a turn the exploration project will look for deposits, expense operations apply cash flows, and will report progress via a messaging system. The messages from all projects are displayed during when a turn is ended, but only the most recent message is displayed.



End of turn project messages.

Some projects may generate multiple messages in a turn, and the only way to see these messages is to click on the project during the next turn. Clicking on the project brings up the manage project window for that project, in which the last eight project messages are displayed. The Manage project window is detailed later in the Manual under Part V, Firm Valuation and Performance Tracking.



Manage project window—messages are highlighted in this diagram with a red box. The green box highlights projected quarterly cash flows.

After one turn of exploring, the reserve map overlay (toggled by pressing the "R" key) will display the appropriate color marking (orange for no reserves found, pink for possible feasible reserves). **It may take multiple quarters of exploration in the same area to find a deposit.** Initially the probability of successfully finding reserves in a location wherein they exist is 1 in 10, assuming equipment and human resource quality for the project is set to five (five is the maximum). As a firm's technology advances, exploration becomes more reliable. Technology is advanced through research projects, covered later in this section. Exploration projects consist of the following quarterly cash flows, all of which are fixed:

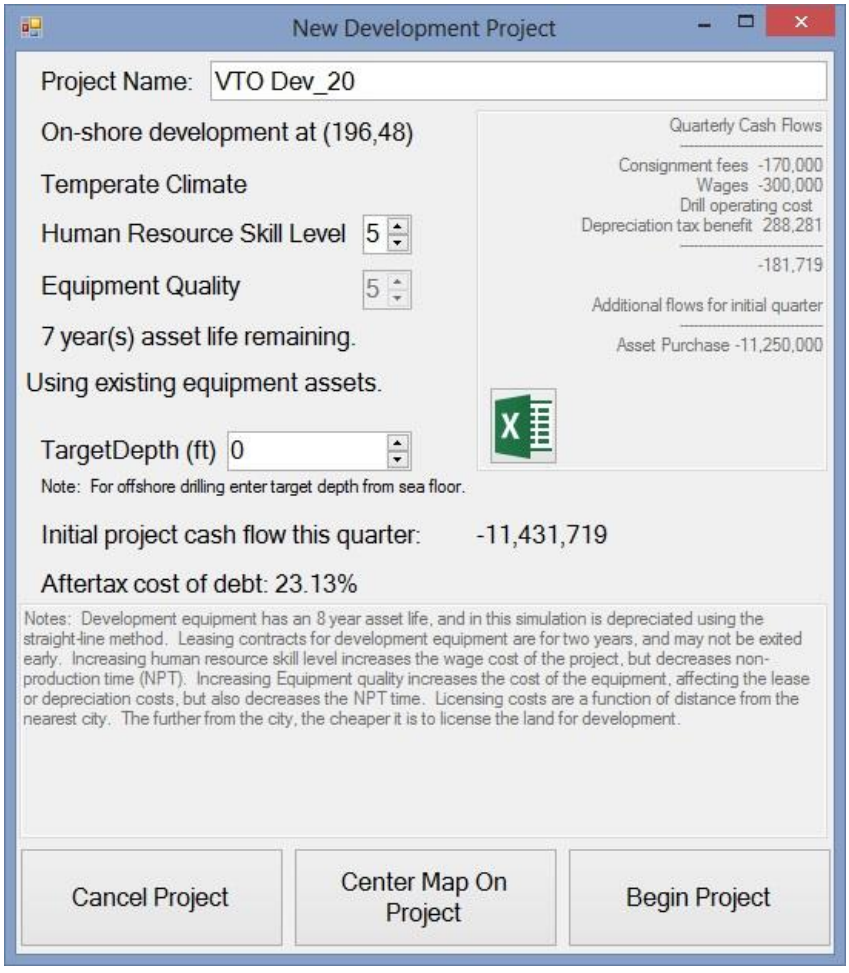
- **Outflow.** Consignment fees equal to ($100,000)-(distance to nearest city in tiles)
- **Outflow.** Wages equal to ($50,000) + (HR Skill Level * $10,000) for onshore. Equal to ($100,000) + (HR Skill Level * $20,000) for offshore.
- **Outflow.** Equipment costs equal to ($50,000) + (Equipment Quality * $10,000) or equipment lease payment equal to [($50,000) + (Equipment Quality * $10,000)] / (14 years * 4 quarters) for onshore. Equal to ($100,000) + (Equipment Quality * $20,000) or equipment lease payment equal to [($100,000) + (Equipment Quality * $20,000)] / (14 years * 4 quarters) for offshore.

- **Inflow.** Tax benefit from depreciation equal to [Equipment expense / (14 * 4)] * (1 - tax rate). Tax benefit from a lease equal to [(Lease payment) * (tax rate).

Hint: When selecting lease or buy, different cash flow projections are displayed. Discounting the net difference over the project's life at the after tax cost of debt is useful for determining the most beneficial method.

Development Projects 

Once an exploration project finds evidence of feasible reserves, a development project should be initiated on the same tile. Right click on the successful development project (use the reserves map--, toggled with the "R" key--to help identify the successful exploration project), select New Project->Development. This displays the New Development Project window.



New development project window. Note the target depth selector.

Development projects include the drilling of an exploratory well, as well as an assessment of any strike. All of this information is relayed via project messages, displayed at the end of a turn and also in the manage projects window. Variables for development projects are similar to exploration projects, but with the addition of a target depth selector. This is the target depth for the team to drill. Once a turn is

ended and a development project exists, the rig team will attempt to drill to the selected depth. The maximum drill depth is dependent on the firm's technology level, which is advanced with research projects.

Technology Level	Maximum Drill Depth
0 (Start)	5000 ft.
1	10000 ft.
2	17000 ft.
3	40200 ft.
4	40200 ft.
5	40200 ft.
6	40200 ft.

Technology levels and associated maximum drill depths.

Cash flow projections for development projects are less reliable, as unforeseen circumstances may arise while drilling. Drilling projects are maintenance problems, which create non-production time (NPT). Using high quality equipment can help reduce but not eliminate NPT time. Cash flows for drilling projects are as follows:

- **Pro-rated outflow.** Consignment fees equal to ($100,000)-(distance to nearest city in tiles)
- **Pro-rated outflow.** Wages equal to ($250,000) + (HR Skill Level * $10,000) for onshore. Equal to ($500,000) + (HR Skill Level * $20,000) for offshore.
- **Outflow.** Equipment costs equal to ($10,000,000) + (Equipment Quality * $250,000) or Equipment lease payment equal to [($10,000,000) + (Equipment Quality * $250,000)] / (8 years * 4 quarters) for onshore. Equal to ($20,000,000) + (Equipment Quality * $500,000) or Equipment lease payment equal to [($20,000,000) + (Equipment Quality * $500,000)] / (8 years * 4 quarters) for offshore.
- **Outflow.** Drill operating costs include costs such as drill pipe, drill bits, and drill mud, all expensed on a per foot basis. Onshore drilling costs are equal to (drill depth * $230), and offshore drilling costs are equal to (drill depth *$460).
- **Inflow.** Tax benefit from depreciation equal to [Equipment expense / (8 * 4)] * (1 - tax rate). Tax benefit from a lease equal to [(Lease payment) * (tax rate).

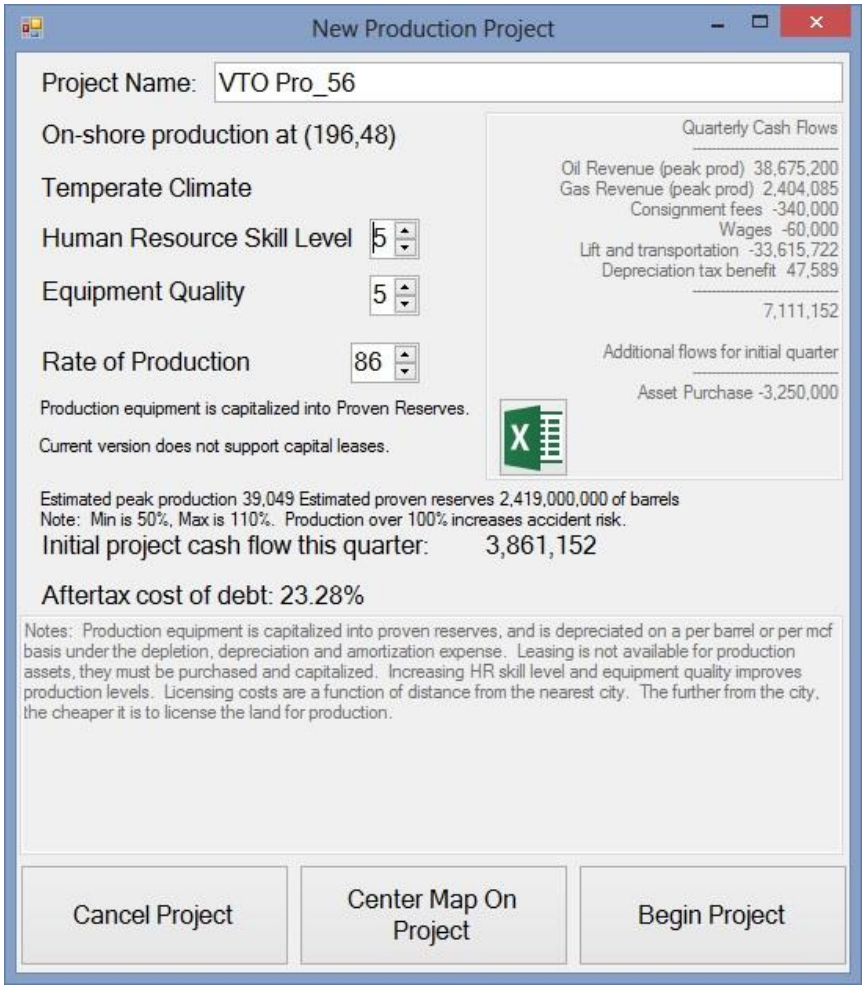
If a drilling project has been initiated, the rig team will drill up to 91 days in order to reach the target depth. The average drill rate for the simulation is set at 500 feet per day, and is not currently set up to change with technology. Some simulation fidelity is sacrificed here, and graduated drilling rates may be introduced in a later release. Once the target depth is reached, the drilling ceases. Wages and consignment fees are pro-rated based on days drilled, while equipment expenses are expensed on a quarterly basis. Finally the drill operating costs are added to calculate the final cost of the project for the quarter.

If a development project reaches the maximum depth allowable based on current technology, an unfeasible tile will show up on the reserve map overlay (yellow tile). This indicates the reserves are

unfeasible with current technology. Should new technology be discovered, it is worthwhile to re-examine yellow tiles for feasibility on the reserve map. If at the end of a turn a strike occurs, a gusher (onshore strike) or large gas flare (offshore strike) will be visible on the project's sprite. *Note:* A strike of shale oil will still yield a gusher, regardless of availability of shale development technology.

Production Projects 

Once a development project yields feasible reserves, a production project can be initiated. During this phase the final casing is completed and the well is prepared for producing oil. Onshore this is accomplished with a "nodding donkey" type pump, and offshore by offshore production platforms. To initiate a production project, right click on a development project with feasible reserves and select New Project->Production. This displays the New Production Project window.

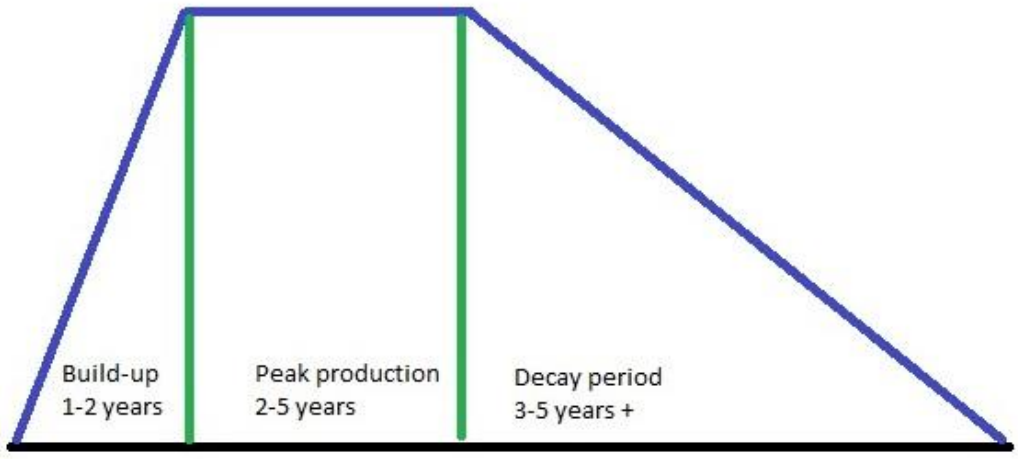


New production window. Note the rate of production selector.

The new production window is similar to the other projects with the exception of the production rate selector. Changing this controls the amount being produced from the well. Above the "Initial cash flow

this quarter" label is a description of the reservoir showing the rate of production at peak and estimated total barrels.

Production is difficult to estimate exactly, but follows a production profile. Production is less at first, but increase over time, plateauing and then eventually decaying. Not all reserves will be produced due to the decaying production profile.



Profile of a production project.

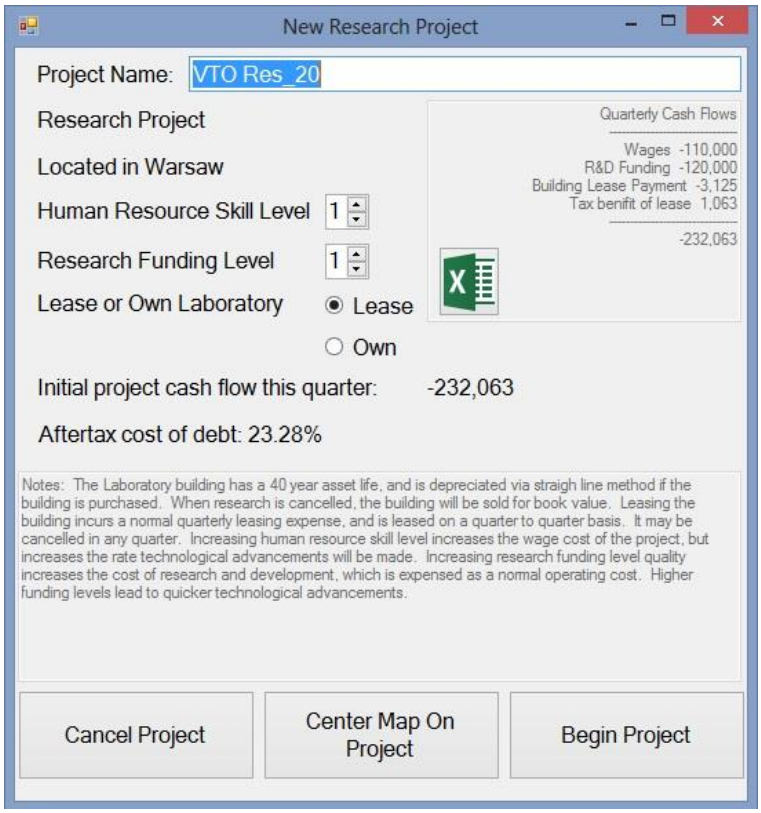
Production projects can only be purchased due to simulation accounting requirements (capital leases are currently unsupported by the simulation). Production cash flows are as follows:

- **Inflow.** Revenues from oil and gas sales equal to (Gas Produced) * (Market Gas Price) + (Oil Produced) * (Oil Price). Natural gas deposits produce natural gas only, while oil deposits produce oil and a smaller natural gas byproduct.
- **Outflow.** Consignment fees equal to ($100,000)-(distance to nearest city in tiles)
- **Outflow.** Wages equal to ($50,000) + (HR Skill Level * $10,000) for onshore and offshore.
- **Outflow.** Equipment costs equal to ($2,000,000) + (Equipment Quality * $250,000) for onshore. Equal to [($30,000,000) + (Equipment Quality * $750,000)] for offshore. Equipment costs are capitalized into proven reserves (accounting is covered in more detail in section V).
- **Outflow.** Lifting costs equal to (barrels or mcf produced) * ($11 for oil or $1.57 for gas) for onshore. Equal to (barrels or mcf produced) * ($9 for oil or $1.31 for gas).
- **Inflow.** Tax benefit from depreciation is equal to (Depletion, Depreciation and Amortization Expense) * (1 - tax rate).

Offshore production is expensive, so care must be taken to ensure it is only done in the most productive regions.

Research

In order to access more remote areas for exploration, development and production, a firm should make significant investments in research and development. Initially a firm's technology level is set to zero, with six levels of technology that may be obtained. Research projects can be initiated by right clicking on a city square and selecting New Project->Research Project. This displays the research project window.



Research project window.

The New Research Project window is very similar to other project windows. The HR skill level represents the quality of researchers involved in your research project, and along with the funding level directly influences how quickly a new discovery is made. After ending a turn, any research projects report back how far they have come towards advancing the firms technology level. In addition to the benefits described below, each technology level improves exploration projects' survey accuracy. Below is an overview of technology levels and what they offer:

- **Technology level 1 (TL1).** Allows offshore exploration drilling in protect coves and waterways. For a TL1 offshore project, at least seven of the 9 tiles on and around a project must be made up of land. Good area with eight land tiles: 

Poor area with six land tiles: 

Additionally this level allows drilling to 10,000 foot depths below the surface.

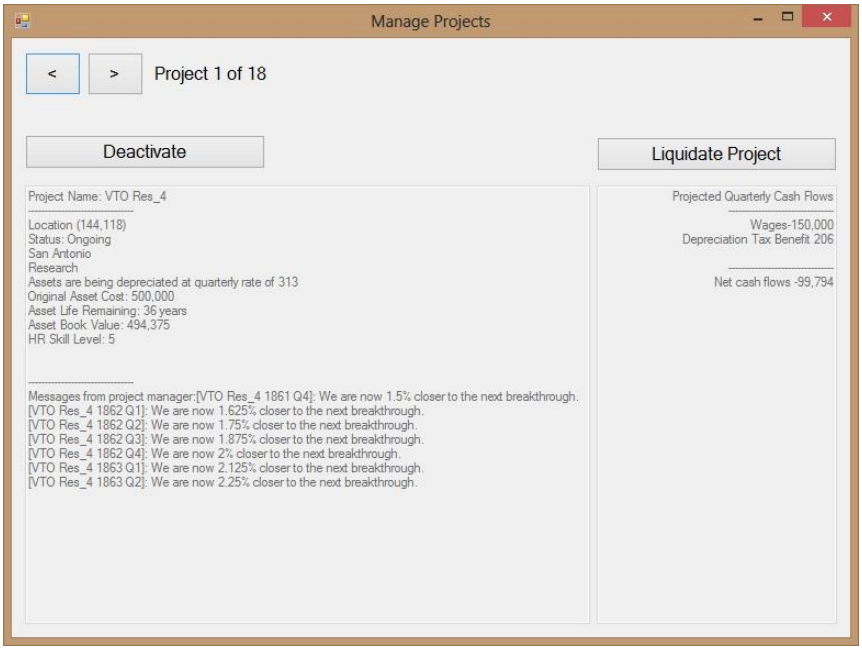
- **Technology level 2 (TL2).** Allows offshore exploration and drilling in open waters in depths of up to 1000 feet. With TL2 a firm mustn't worry about ensuring an appropriate amount of surrounding land tiles. Allows drilling to 17,000 foot depths below the surface. For offshore projects this means a total depth of 18,000 feet (1000 foot sea depth + 17,000 depth below seafloor).
- **Technology level 3 (TL3).** Allows offshore exploration and drilling in depths of up to 3000 feet and increases max drill depths below hard surface to 40,200 feet.
- **Technology level 4 (TL4).** Allows offshore exploration and drilling in depths of up to 7000 feet.
- **Technology level 5 (TL5).** Allows offshore exploration and drilling in depths of up to 10000 feet.
- **Technology level 6 (TL6).** Allows offshore exploration and drilling in depths of up to 35000 feet, and allows arctic exploration and development operations.

V. Performance Tracking

There are three main tools in the simulation for tracking your firm's performance: the manage projects window, the financial reports window, and an assortment of charts. Additionally there is a market info window that shows information on oil prices, GDP, and an artificial stock index (The Weighted Firm 500). The market info also displays firm variance, covariance and beta (measured against the Weighted Firm 500). To access the market info, select Market Info from the main interface menu (right click to bring up).

<u>Manage Project Screen</u>

There are two ways to access the manage project screen. The first method is to left click on a project sprite on the main interface map. The second method is to right click on the main interface map and select Manage Projects. This displays the Manage Projects window.



Manage projects window.

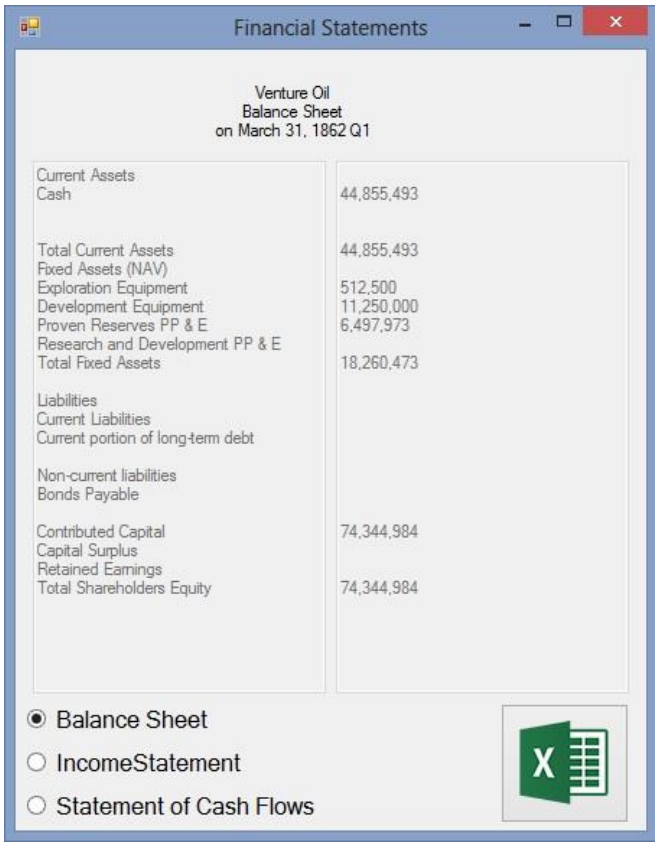
From the manage project window project information on the project may be viewed on the left, as well as projected quarterly cash flows on the right. The last eight messages from the project manager appear in the bottom half of the window. From this window the user can cycle through other projects with the arrow keys, and deactivate or liquidate projects.

Deactivating the project maintains an ownership claim to the tile, but eliminates any operational costs. In most cases the only costs for a deactivated project are consignment fees. Liquidating a project sells of any owned assets and dissolves the project. Assets are sold for their book value. **Leases can only be liquidated (cancelled) after the first eight quarters of a projects operation, which simulates associated contractual obligations.**

The manage project window also allows the user to set production levels for production projects (via a percentage rate selector), and set new target depths for drilling projects.

Financial Statements Window

The financial reports window appears every time the user ends a turn, and also when the user selects financial reports from the main interface menu (brought up by right clicking on the main interface map).



Financial statements window. Note the Excel export button (see Part X).

By selecting the appropriate button different financial statements may be displayed. Each financial statement is representative of the previous quarter.

Charts

Assorted financial charts are available for viewing by selecting Charts->[chart type] from the main menu (brought up by right clicking on the main interface map). Available charts are:

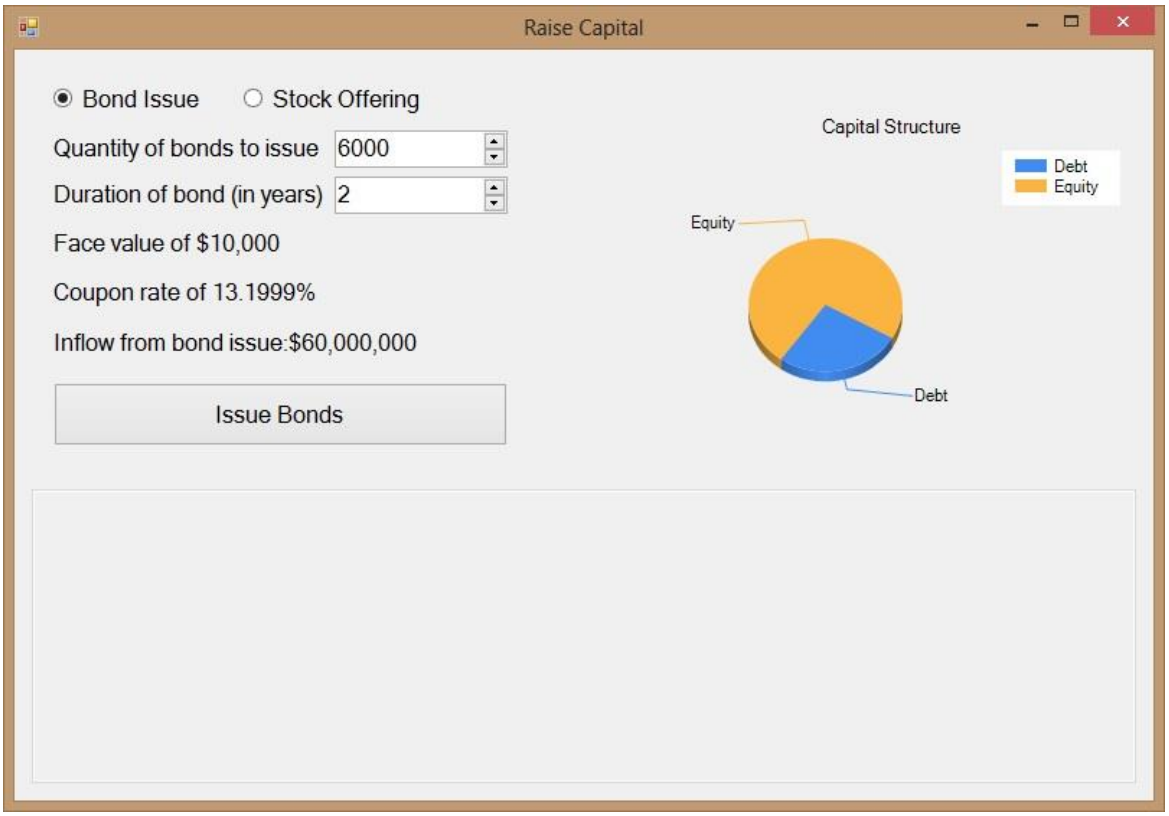
- **Oil/Gas Prices.** Displays oil and gas price trends over the last 25 years.
- **Equity**. Displays the total shareholder's equity over the past 25 years (from the equity portion of the balance sheet) for all five firms in the simulation. *Note: This amount is strictly from the accounting statements, and is not related to the share price or market capitalization.*
- **Net income**. Displays the net income over the past 25 years for all five firms in the simulation.
- **Market share.** Displays the current market share for the firm compared with the other five firms. This does not include market share from state-owned enterprises, which exist in the background of the simulation.
- **Cash holdings.** Displays total cash holdings from the cash account on the balance sheet over the past 25 years for all five firms.
- **Market capitalization.** Displays the total market capitalization of the firm over the past 25 years.

Oil and gas prices, oil priced per barrel, gas per mcf.

Once activated, a chart will automatically update as turns are ended.

VI. Raising New Capital

There are two ways to raise new capital in the simulation. The first is with a bond offering, the second through a stock offering. Stock offerings are only available when the firm is performing well, otherwise investors will not be interested in a wildcatting energy company. Bond offerings are almost always available, but a poorly performing firm will pay extremely high interest rates on the bond. *Currently bond interest rates remain the same regardless of the duration of the bond, an area the simulation lacks fidelity.* To raise capital, right click on the main interface map to bring up the menu, and select Raise Capital.



Raise capital window. Note the pie chart displaying the proposed new capital structure.

When bonds are selected the quantity of bonds and duration may be selected. The coupon rate (cost of debt) is also displayed. A firm's coupon rate corresponds to investors' assessment of the firm's risk. If a firm has been performing well, the stock offering button is enabled. **Initially a firm is a private concern, and issuing its first stock is accomplished through an IPO.** The firm's board regulates the amount of stock a user must issue, and the will not allow two stock issues in one quarter. Furthermore, seasoned offerings may not be sold in entirety if investors believe the firm is having cash flow troubles.

VII. Shortcut Keys and Autorun Feature

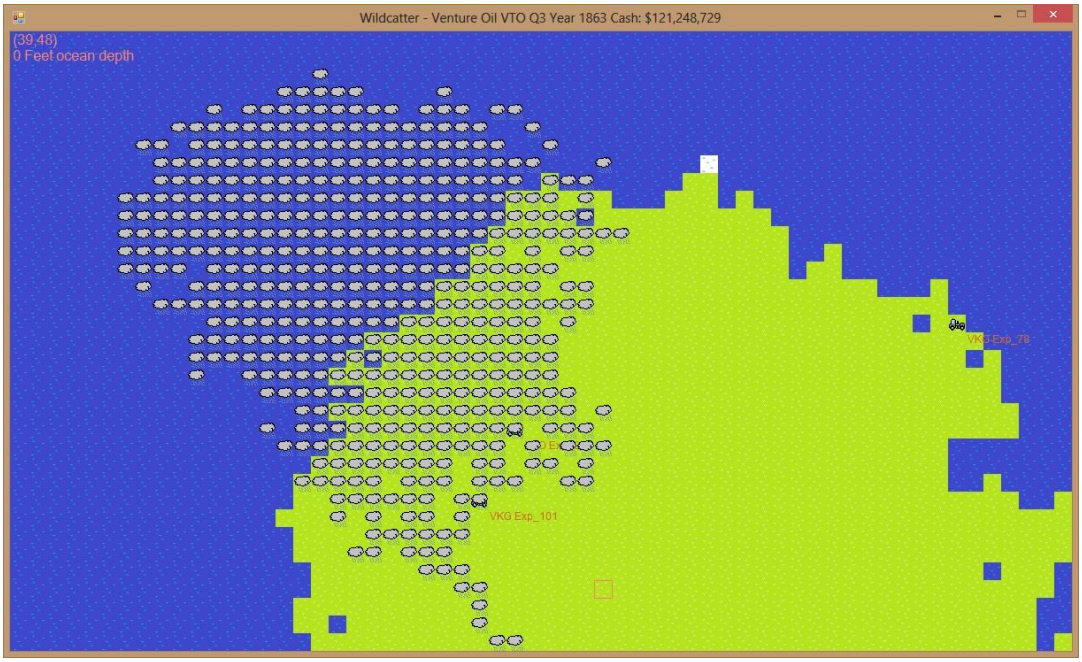
Wildcatter features several "hotkeys" which perform different operations when pressed. To activate a hotkey command, press the appropriate key on the keyboard:

- **"Z"** ends the turn in the same way as the end turn command available from the main interface menu. Displays the financial results and messages from previous quarter.
- **"R"** toggles the reserve map overlay.
- **"A"** toggles the autorun feature, discussed below.

Autorun is a time lapse feature that allows rapid progression through simulation quarters. When autorun is toggled on, the simulation begins continuously ending. This is useful can be useful to progress quickly to a different era of oil exploration. Ensure revenue producing projects and research projects exist before engaging autorun, otherwise the firm's technology progress will stagnate and cash holdings may fall precipitously. While autorun is engaged, the artificial intelligence subroutine takes over the user's firm, initiating and cancelling projects without input from the user. **To witness the full capability of the simulation, open all charts and engage autorun.** Charts are updated in real time when autorun is engaged.

VIII. Weather Effects

The simulation includes weather effects, which occur randomly throughout the game. There are three types of weather events: Hurricanes, thunderstorms and sandstorms. Thunderstorms and hurricanes usually form near bodies of water, and sandstorms form in the desert. If a weather event occurs in a tile containing a project, that project will suffer damage and cease operations for the quarter. Weather damage is listed as an extraordinary expense on the income statement.



A hurricane affecting some projects near the coast.

IX. Understanding Firm Valuation

The firm uses corporate finance formulas to valuate firms in the simulation. The firm calculates market capitalization by dividing the most recent net income by the difference between weighted average cost of capital and most recent growth rate for net income:

$$\frac{net\ income}{(WACC - growth\ rate)}$$

This value for market capitalization is then averaged with market capitalization values from the previous four years, providing a smoothed market capitalization value.

The simulation calculates WACC using the traditional formula:

$$COE \times \frac{S}{S+D} + COD \times \frac{D}{S+D} \times (1 - tax\ rate)$$

Where *S* is the market value of equity, and *D* is the market value of debt.

The firm calculates COE using the Capital Asset Pricing Model, but with one difference. In order to avoid a circular reference issue, the firm calculates beta in relation to the firm's equity account from the balance sheet, instead of the market value of equity as in traditional corporate finance. This was the best method the author found for incorporating CAPM into the simulation and avoiding the circular reference. COE is calculated:

$$R_f + \beta(R_a - R_f)$$

Where R_f is the risk free rate and R_a is the risk of the security. Since CAPM is directly incorporated into WACC, and the WACC formula is the **sole** valuation method for the simulation, using a beta calculation that tracked the firm's actual market capitalization creates the circular reference situation. Once beta is calculated, it is smoothed over the past ten years of the history. During the firm's intial years the smoothing is accomplished by assuming a beta of 1.5 for the previous ten years.

COD is calculated based on the firm's likelihood for default, and incorporates several liquidity ratios and correlates them with an internal table of debt interest rates.

X. Exporting data to Excel (new for v0.3)

Data from the Wildcatter Simulation (version 0.3 and later) can now be exported to Excel. Simply click on the excel icon  , which can be found on the financial statements window and on all project windows.

Exporting project cash flows represents an excellent opportunity to conduct discounted cash flow (DCF) analysis. Please note that each time you click on an export button a new instance of excel is started, so be sure to save and close Excel when you are finished.

XI. Comments and Feedback

Feedback and suggestions are welcome. Please direct them to: wildcattersimulation@gmail.com or follow send us a tweet on Twitter: @WildcatterSim.