Advanced Modding Guide

Contents

Introduction

Before reading this guide you should make sure that you read the main website's modding guide: https://www.capitalismlab.com/mod/. This guide should be read as a detailed supplement to the main guide on the website.

This is an advanced guide to modding Capitalism Lab – this guide will provide extensive details into the inner workings of modding the game along with some advice on how to align your mod in game with your creative vision as a well as how to make it better for a general audience if you publish it. This guide is written in part due to the various different problems I found when I was creating my first mod (Magitek), and so I thought it might be worthwhile to mention these common pitfalls so that you don't waste as much time.

This is not a gameplay guide nor is an attempt to get you to create any kind of specific mod. This is just a guide on how to make the process easier in general and saving you from a lot of unnecessary frustration and to also avoid many of the problems I commonly see in a lot of other mods (which I will detail below). I will also mention other features of mods that might interest you and introduce you to the more interesting possibilities for modding, with reference to mods made by others.

This guide will have the following sections:

- Mod Theme and Creative Process
- Basic things to check before starting
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Mod Theme and Creative Process

During your play of Capitalism Lab you have most likely tried out the various other mods, such as the RealWorld MOD, Modern World, Capitalism World, Magitek, etc. and thought about making one yourself. Don't be afraid to jump in, modding is actually quite easy and straightforward and the Capitalism Lab code is very accommodating to the adding of new products, pictures, companies, people, resources, etc. through some very easy to edit files and ready-made batch files that will put the files together.

Before making a mod here are some things I would advise you to think about:

1) What theme or purpose does your mod have? If you have a look at the other mods you will notice that many of them have an overarching theme to them, for example RealWorld simulates the complexity of the real world we live in by adding lots and lots of new products and creating a much more complex supply chain, Future World simulates a vision of a futuristic world of AI, Robotics, Self-Driving Cars, Prosthetic Organs, etc and Magitek simulates a world of fantasy magic colliding with a modern industrial society.

Not all themes must involve extensive transformation of the entire game, for example the Auto Empire Mod adds a variety of new automobile brands but keeps all other products the same.

Overall it would be good to have a general theme in mind, even if that theme is as simple as making minor gameplay balance changes. That way you can avoid being side-tracked by irrelevant changes and you can make your products, categories, services, etc. fit a consistent pattern.

2) Who is your target audience? This is something to think about if you are publishing a mod to the public. For many mods the target audience is a certain type of Capitalism Lab player that is seeking something such as:

- A much wider variety of products/services to choose from such as in the RealWorld, Modern World or Capitalism World mods.
- A unique or novel twist or speculation on the real world such as in Future World or Magitek.
- A historical theme such as Modern World Retro.
- Challenging gameplay or interesting gimmicks.

Feel free of course to set your own path, the above are just some basic guidelines to help you stay focused on creating a high quality mod.

3) What DLCs do you want your mod to work with? Many mods are designed to only work with at least some or all of the in game DLCs installed. It is easy to create a mod that can work with just the base game (with no DLCs) as the game's code will simply exclude any modded items intended for only the DLCs (for example new software meant for the Digital DLC will simply not appear if Digital DLC is switched off). However this may have gameplay balance implications, particularly for the Service DLC. I will make additional remarks on this later under the 'Gameplay Balance' section.

Basic things to check before starting

Before you begin modding you should do the following:

- Make sure that you have played at least a few different user created mods. I recommend RealWorld, Capitalism World and Magitek as three excellent mods that showcase some extremely creative uses of the Capitalism Lab gaming engine. I will discuss some of the more interesting ideas in these mods later.
- Read the Modding Guide on the main website: https://www.capitalismlab.com/mod/how-to-make-a-mod/
- Install the latest version of Capitalism Lab
- Download the Mod Kit (either MOD_Kit_Service or MOD_kit) from https://www.capitalism2.com/forum/viewtopic.php?t=9618
- Download and install OpenOffice to allow the DBF files to be opened.

Helpful Tools

In general I found the following to be very useful for creating mods:

- An AI Image Generator such as Microsoft Copilot, Crayion or ChatGPT. This can help you create new, original and copyright free images to use for the various in game graphics. I will give some advice on how to use these tools later in the guide.
- Remove Background tool: https://www.remove.bg/. Useful if the AI generated images have unwanted items in the background (which occurs frequently).
- Imagemagick, to create very small and scaled down images of your products for the Firm Product Icons.
- The Mod Analysis Tool in Capitalism Lab – use Alt-M at any time in game to activate this and you can run an analysis on any in game product. I will describe this in detail later in the guide.
- The Modding Forum for Capitalism Lab, where you can ask questions or read the answers to previously posted questions: https://www.capitalism2.com/forum/viewforum.php?f=39

How to create new things

Capitalism Lab is very versatile in terms of what you can mod. You can add (or remove) any of the following things:

- Products (including Raw materials, Livestock, Crops, Semi Products, Software and Service products).
- Firms (including new Retail, Service, Factories, Farms, Apartment Building firms, etc).
- Technologies used for Software and Internet Companies (or even optionally products).
- Layout plans for Farms/Factories.
- Miscellaneous in game text and data such as city/company/freight types/person/political party names, the top 100 billionaires list, etc.

For all of the above changes you can also add the accompanying stats and graphics to go with them.

In general the procedure for creating the above is detailed on the website's modding guide (https://www.capitalismlab.com/mod/how-to-make-a-mod/), however I will create a brief overview of how to create each of the above features:

Product Creation

Products in Capitalism Lab read data from the following files:
Farm_Crops.dbf
Farm_Livestock.dbf
Farm_Livestock_Products.dbf
Manufacturing.dbf
Natural_Resources.dbf
Product_Classes.dbf
Product_Mega_Classes.dbf
Product_Types.dbf
Retail_Store_Products.dbf
Service_Firm_Products.dbf

For Digital DLC Products
Hardware.dbf
Operating_Systems.txt
Software_Classes.dbf
Software_Mega_Classes.dbf
Software_Tech.txt
Software_Types.dbf

Optional
Product_Tech.txt
Product_Names.dbf
Product_Freight.dbf (Service DLC only)

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That's a lot of different files! Don't be intimidated however; the process for understanding them is reasonably straightforward.

Manufacturing and **Product_Types** are both used for individual product types. Anytime you want to create a new product you must add a new entry to both of these files. Manufacturing tells the game what materials to make the product out of. **Product_Types** gives the product its name, price, level of demand, R&D characteristics (if applicable), etc.

If you are creating a new product to an existing category and you are not adding any new Raw Materials/Farm products then these are the only two files you will ever need to change.

Product_Names is a special, base game file. You should only ever need to touch this file if you are trying to change the name of a product which already exists in the base game; there is no other reason for this file. Don't add any lines to it for your new products.

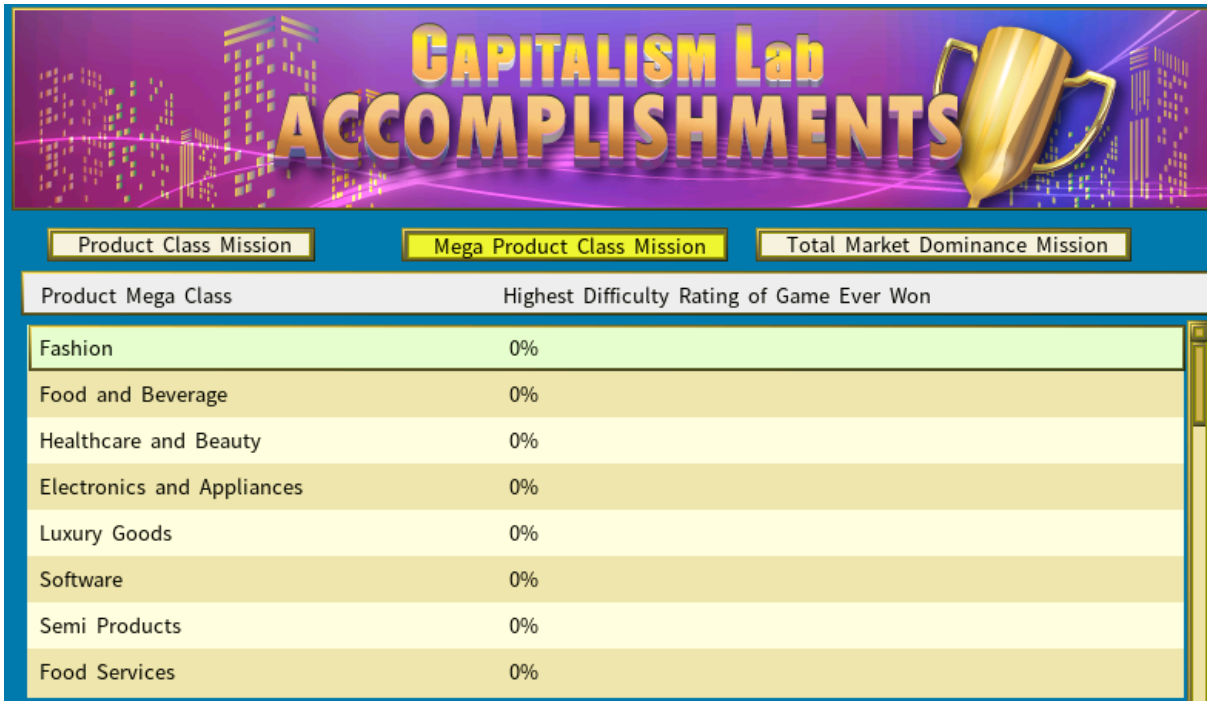
Natural_Resources is used to tell the game what natural resources exist in the game. That is the resources that come out of the Mines, Oil Wells and Logging Camps (not farms). Remember that any natural resource you add to the game MUST have an entry in both **Natural_Resources** AND **Product_Types**.

Product_Freight.dbf is used by the Service DLC's Logistics firm to classify the product into the appropriate transport category. For example Frozen Pork will use Refrigerated Cargo; Iron Ore will use Bulk Cargo, etc. If you don't put an entry into this file then General Cargo will be the default for that product so changing this file is optional.

Farm_Crops, **Farm_Livestock** and **Farm_Livestock_Products** are used to tell the game what crops or livestock exist in the game. **Farm_Crops** is used for farms that grow crops (i.e. the farm products that must go through a period of Sowing and Harvesting such as Wheat). All crop products must have an entry in **Product_Types**. For livestock products you will need an entry in **Farm_Livestock** to tell the game what livestock exists and what products (up to 3) can be produced from them (for example Cattle can produce Frozen Beef, Milk or Leather). **Farm_Livestock_Products** is then used to determine the speed of the livestock product production on the farm (as well as the start/end month, which is used for Wool). Any new Livestock and their products must be specified in **Farm_Livestock**, **Farm_Livestock_Products** and **Product_Types**.

Product_Classes is used to add new classes of products to the game, for example Furniture, Food, Automobiles, etc. A product class can also be added to a product megaclass, but this is optional.

Product_Mega_Classes is used to add new Product Megaclasses. A megaclass can be used to set certain product objectives in your mod such as in the Mega Class Product Missions (shown below). It is also used by the AI to guide their decisions in terms of what product categories are related to one another so that they can make more rational choices.



Retail_Store_Products and **Service_Firm_Products** are used to tell the game which product category belongs in which store. For example a Supermarket can have Food, Snacks, Beverages, etc) while a Furniture Store only has Furniture. **Service_Firm_Products** is the same, but for service products (there is also an additional factor that controls customer traffic boosts to nearby stores).

Digital DLC Products

Software_Mega_Classes , **Software_Classes** and **Software_Types** are similar to that of Products. If you want to add or change a Software Product you should do so via **Software_Types**, which works almost the same as **Product_Types**. **Software_Classes** is used to determine classes of software such as Audio Software, Video Software, etc and you can make a new category in there if you want. **Software_Mega_Classes** is used for the broader classes of software; I have not used this myself so I cannot describe exactly how it works in this case.

Hardware is used by the Digital DLC to determine which base game products can be used for Internet Access. For example the total number of people who can be customers for Internet Companies and Telecom Firms is determined normally by how many Desktop Computers and Notebook Computers have been purchased in the cities. If you want to add a product that is capable of connecting to the internet then add it to this file.

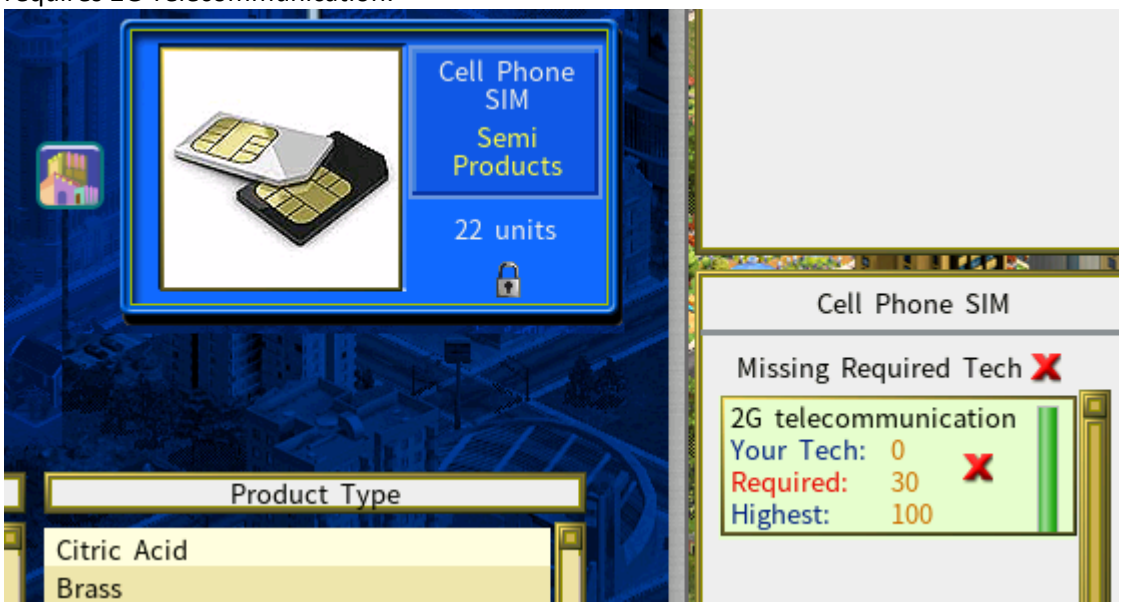
Operating_Systems is used to determine what computer hardware is permitted to run on an Operating System. The instructions in this file are bit hard to follow, but basically in the base game there are only two products that can run an OS, Computers and Notebook Computers. If at the start of the game your operating system is set to run only on Desktop Computers then this is no problem when Notebook Computers are invented as the operating system will be automatically compatible with it. This is done by using the line:
NOTEBOOK, COMPUTER

This indicates that the Notebook Computer will work with the Computer. If you want to add more computers that support Operating Systems then you should do so by adding it as follows:

YOURPRODUCTCODE, COMPUTER

For more complicated changes you should ask on the modding forums as I have not really explored this in substantial detail.

These tech related files: **Product_Tech** and **Software_Tech** control the techs required for certain products. In the base game normally a product can be subject to R&D; however you can instead make a product dependent on researching tech instead. For example in the RealWorld mod various products require you to research a tech to unlock certain products such as the Cell Phone SIM, which requires 2G Telecommunication:



Once the Required Level is reached in game, the product will be invented.

Software_Tech is basically the same, but in this case for the Software products.

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For more exact tips on how to set things such as Demand, Price, etc. please see the Gameplay Balance section.

Firm Creation

Capitalism Lab mods can also accommodate new firms. New firms can serve the following purposes:

- New retail or service firms for new categories of products in services. For example in Magitek a new product category: Wands and Spellbooks can be sold in a Wand Shop.
- New apartment or commercial buildings to enable a greater diversity to the city skylines as well as adding higher capacity buildings to save space on the map.
- New factories or farms to increase or decrease the capacity of production beyond what the base game allows (for example Small Farms and Mega Factories in the RealWorld mod).
- Just simply adding greater variety in general.

The modding guide on the website will explain how to create new buildings, my guide is simply a brief overview of this process:
https://www.capitalismlab.com/mod/advanced-modding/advanced-modding-buildings/
https://www.capitalismlab.com/mod/advanced-modding/advanced-modding-adding-new-buildings/

The game will read from the following files in relation to firms:

Buildings.dbf
Building Modifiers.dbf
FBuildStd.dbf
Internet_Companies.txt
Retail_Store_Products.dbf
Service_Firm_Products.dbf

These files are easy to understand:

Buildings is the file which contains all entries for all *new* in game firms. Use this file to add new retail stores, factories, apartments, etc. If you don't know which code corresponds to which firm type see the **FBuildStd** which will give you a complete list.

Building Modifiers is the file which allows you to modify all *existing* game firms. Use this file to modify existing retail stores, factories, apartments, etc. If you don't know which code corresponds to which firm type see the **FBuildStd** which will give you a complete list. Note that the numbers in this file represent the *percentage* costs or space used by these buildings in the original game stats (which are hardcoded). **FBuildStd** will contain the original statistics that you can reference.

FBuildStd is the file which contains all entries for all *existing* in game firms. This file is purely for reference only (so that you can see what building categories exist and what their existing stats are). No changes in this file will affect the base game firms at this time.

Retail_Store_Products and **Service_Firm_Products** have already been explained for products above; basically you need to add new entries to these files so that your new firms can actually sell products. If you don't add an entry here for your retail/service firm then it can still be built but it will be completely useless. For other firms like Factories or Farms you can ignore these files.

Internet_Companies is a text file that will let you add (or remove) internet firms from the game. The instructions in the text file, along with the existing firms should be straightforward in terms of creating or removing internet company types.

Creating Technologies (Digital DLC only)

There are three files which control in-game tech:
Tech.dbf
Tech_Classes.dbf
Talent_Names.txt

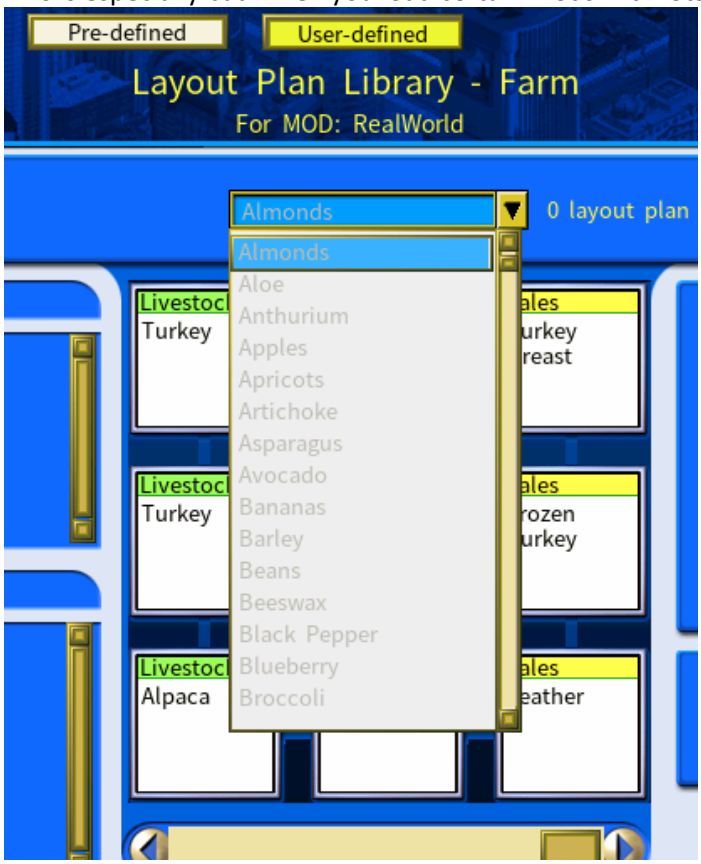
Tech and **Tech_Classes** are both relatively straightforward in how they work; the Tech file lists out of all the techs used for Software and Internet Companies and Tech_Classes sets the class they belong to. In general the tech class is only really useful to decide if the tech can be created within a Software Company or an R&D Center. If it is classed as Software it only appears in Software Firms, if it is classified as anything else it appears in the R&D Center.

Talent_Names is used for the names assigned to R&D/Software Talent. If you want to add or remove names from this file then you can do this here.

Creating Layout Plans

Something I have never seen in other used created mods but is essential: from a player Quality of Life standpoint: Layout Plans. Whenever you load a user created mod or create a mod all of the base game layouts are gone, this means that anytime you build a farm for example you have to create the

layout from scratch (this applies even for base game products such as Frozen Chicken or Wheat). This is especially bad when you load certain mods with lots of different items like RealWorld:



The only exception that I know of is the Magitek mod; if you load this mod you will be given a number of useful farm layouts the moment you set up a new farm:

The reason why is because I loaded up my mod in game, and then manually added at least one farm layout per product for all of the farm products and then saved the PLO file with the other mod files. If you create a mod, please make sure you do this and save the players a lot of time. See this article for details on how to set this up:
https://www.capitalismlab.com/improvements/layout-plan-libraries-mods/

Note: This setup is only needed for farms, in the case of factories and retail stores most people typically select the + icon which automatically creates a good enough layout no matter the mod.

Creating Other Things

Aside from Products and Firms the game lets you change the following files:

Billionaires.dbf
Cities.dbf
Companies.dbf
Company_Details.txt
Construction Blueprints.txt
Fictional_Cities.dbf
Freight_Cat.dbf
Influential.dbf
Logos.dbf
Persons.dbf
Political_Parties.dbf

Stocks.dbf

Billionaires is the file used to name the top 100 Billionaires, along with their financial wealth.

Cities is used to change the in game cities. See this article for details: https://www.capitalismlab.com/mod/advanced-modding/advanced-modding-cities/

Fictional_Cities is used for the random city names that appear in custom games.

Freight_Cat is used to add/remove or change Freight Categories for the Service DLC Logistics firm. You can use this file to add your own freight categories or to modify the freight costs of existing categories. Be sure to look at **Product_Freight.dbf** to determine which products belong to which category.

Companies is used for the randomly assigned company names in the game such as Super Force, Concept Bright, etc. See here for further details on this: https://www.capitalismlab.com/mod/how-to-make-a-mod/.

Company_Details is an optional file that allows you to link specific AI Persons to a specific company. For more details see this article: https://www.capitalismlab.com/link-ai-persons-specific-companies/

Construction Blueprints and **Logos** are never used, please ignore these files.

Influential is used for the most influential people list in the City Economic Simulator DLC.

Persons is used for the in game person names, including their gender and their (required) image file name. You may also optionally set character and expertise traits if you want a specific name to have specific characteristics (for example having a real world person with characteristics that match their real world expertise or business character).

Political_Parties is used to generate the names of the political parties in City Economic Simulator DLC. You can set the political characteristics of the parties such as their taxation preferences.

Stocks is used in the Banking and Finance DLC to set the names and characteristics of all of the companies featured on the Global Stock Exchange.

Images

In Capitalism Lab various images are used for Products, Firms, Persons, Company Logos, Technologies, etc. Most of these images can be changed and new ones added by putting the relevant image in the required folder. The instructions for adding images can be found in the website modding guide, the following is a brief overview of what changes require which images:

Products – It is optional but highly recommended that all new products are provided an image. Images should be added for all new Cattle, Raw Materials, Crops, Livestock Products, Semi Products and Consumer items. All products should also get a smaller 40X40 image for the Firm Product Icons feature: https://www.capitalism2.com/forum/viewtopic.php?t=9811

Software – It is optional but highly recommended that all new software products are provided an image. Software images are added to the Software folder.

Buildings, **Building_Icons** and **Firm_Images** – These folders pertain to the images used for most of the in game firms. The Buildings folder is used for the Large, Medium and Small sprites viewed in-game. Building_Icons is used for the building image in the construction menu. All new firms MUST have an image in both of these folders or the mod will refuse to load. **Firm_Images** is an optional set of images for the 'Interior' of the firm. Instructions for Building images can be found in the following articles:
https://www.capitalismlab.com/mod/advanced-modding/advanced-modding-buildings/
https://www.capitalismlab.com/mod/advanced-modding/modding-firm-images/

Freight – This is used to modify the icons used by different freight categories in the Logistics Firm. You can use this to add your own product category images or to change the existing ones.

Jobs - These folders pertain to the images used for various units within in game firms such as Purchasing Units, Inventory, Sales, Advertising, Food Preparation, etc. If you add new Service or Farm products make sure that you add a corresponding image as well for the 'Prepare' or Livestock Raising and Processing Units:

Tech – This folder allows you to add pictures for technologies that will appear in the R&D Center:

Checklist for adding new items

I have written up a series of 'Cheat Sheet' tables you can use if you add something new with your mod. These will specify which files need a new entry if you add a particular item to your mod, for example a new product, a new software product, a new firm, etc. it will tell you exactly which files need an entry and which you can ignore.

Note the following when reading the tables:

Yes means that you must have this file entry/image or the mod will not function or the item will not appear/be completely useless.
Recommended means that the item will still function in game but something (like an image in a certain area) will be missing so you should probably add it anyway to make your mod look nice.
Optional means that you can optionally change the item in a special way using this file (such as Product Tech).
No means that this file/image is completely irrelevant to the item you are adding and you can ignore it.

For Adding New Products (Without Images)

	File Name										
	Product_Types	**Product_Classes**	**Product_Mega_Classes**	**Manufacturing**	**Farm_Crops**	**Farm_Livestock**	**Farm_Livestock_Products**	**Product_Freight**	**Natural_Resources**	**Product_Names**	**Product_Tech**
Product (Retail, Service or Semi Product)	Yes	No (unless new category)	No	Yes	No	No	No	Optional	No	No (unless changing names of base game products)	Optional
Product – Crop	Yes	No (unless new category)	No	No	Yes	No	No	Optional	No	No (unless changing names of base game products)	No
Product – Livestock	Yes	No (unless new category)	No	No	No	Yes (if new Livestock Animal)	Yes	Optional	No	No (unless changing names of base game products)	No
Product – Natural Resource	Yes	No	No	No	No	No	No	Optional	Yes	No (unless changing names of base game products)	No
Product – Software	No (unless new Software Class)	No	No	No (unless new Software Class)	No	No	No	No (unless new Software Class)	No	No	No
Product Class	Yes	Yes	Optional	Yes (for normal Products only)	No	No	No	No	No	No	No
Product Megaclass	No	Yes	Yes	No	No	No	No	No	No	No	No

For Adding New Digital DLC Items (Without Images)

File Name										
	Software_Types	**Software_Classes**	**Software_Mega_Classes**	**Software_Tech**	**Internet_Companies**	**Operating_Systems**	**Hardware**	**Tech**	**Tech_Classes**	**Talent_Names**
Software Product	Yes	No (unless new category)	No	Yes	No	No	No	Yes (unless using existing tech)	No	No
Software Product - OS	Yes	No (unless new category)	No	Yes	No	No	No	Yes (unless using existing tech)	No	No
Software Class	Yes	Yes	Yes	No	No	No	No	No	No	No
Software Megaclass	No	Yes	Yes	No	No	No	No	No	No	No
Internet Company	No	No	No	No	Yes	No	No	No	No	No
Product that can run OS (i.e a Desktop PC)	No	No	No	No	No	Yes	No	No	No	No
Product that can connect to Telecom Company (i.e a Desktop PC)	No	No	No	No	No	No	Yes	No	No	No
Tech	No	No	No	Yes	Yes	No	No	Yes	No (Unless new category)	No
Tech Class	No	No	No	No	No	No	No	Yes	Yes	No
Talent Names	No	No	No	No	No	No	No	No	No	Yes

For Adding New Products (Images)

Folder Names								
	Products	**Software**	**Natural_Resources**	**Tech**	**Jobs – Subfolder: Farm**	**Jobs – Subfolder: Service**	**Internet_Companies – Subfolder: Banners**	**Internet_Companies – Subfolder: Icons**
Product – (Retail or Semi Product)	Strongly Recommended	No	No	No	No	No	No	No
Product - Service	Strongly Recommended	No	No	No	No	Recommended (for Service Unit: Prepare)	No	No
Product – Crop	Strongly Recommended	No	No	No	No	No	No	No
Product – Livestock	Strongly Recommended	No	No	No	Recommended (for both Livestock Raising and Processing units)	No	No	No
Product – Natural Resource	Strongly Recommended	No	Yes	No	No	No	No	No
Product – Software	No	Yes	No	No	No	No	No	No
Tech	No	No	No	Recommended	No	No	No	No
Internet Company – Advertising	No	No	No	No	No	No	Strongly Recommended	Strongly Recommended
Internet Company - Other	No	No	No	No	No	No	Strongly Recommended	No

For Adding New Firms (Files and Images)

	Data File Names				Image Folder Names				
	Buildings	**Building_Modifiers**	**Retail_Store_Products**	**Service_Store_Products**	**Buildings**	**Building_Icons**	**Firm_Images**	**Jobs – Subfolder: Service**	**Landmarks**
Retail Firm	Yes (if new)	No (unless modifying base game firm)	Yes (otherwise firm cannot sell anything)	No	Yes	Yes	Recommended	No	No
Service Firm	Yes (if new)	No (unless modifying base game firm)	Recommended (allows service firms to sell in retail stores if Service Firms = No)	Yes (otherwise firm cannot sell anything)	Yes	Yes	Recommended	Recommended (For Input and Sales units)	No
Landmark	Yes (if new)	No (unless modifying base game firm)	No	No	Yes	Yes	No	No	Yes
Any Other Firm	Yes (if new)	No (unless modifying base game firm)	No	No	Yes	Yes	Depends on firm (check if it normally has an interior image)	No	No

For Adding New Miscellaneous Items (Files and Images)

	Data File Names										Image Folder Names		
	Billionaires	**Cities**	**Fictional_Cities**	**Companies**	**Freight_Cat**	**Company_Details**	**Influential**	**Persons**	**Political_Parties**	**Stocks**	**Logos**	**Persons**	**Political_Logos**
Billionaires List	Yes	No	No	No	No	No	No	No	No	No	No	No	No
Cities (Predefined)	No	Yes	No	No	No	No	No	No	No	No	No	No	No
Cities (for Custom Games)	No	No	Yes	No	No	No	No	No	No	No	No	No	No
Companies	No	No	No	Yes	No	Optional	No	No	No	No	Yes	No	No
Freight Category	No	No	No	No	Yes	No	No	No	No	No	No	No	No
Influential List (CES DLC)	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Persons	No	No	No	No	No	Optional	No	Yes	No	No	No	Yes	No
Political Parties (CES DLC)	No	No	No	No	No	No	No	No	Yes	No	No	No	Yes
Stocks (Banking and Finance DLC)	No	No	No	No	No	No	No	No	No	Yes	No	No	No

How to Set Prices, Demand and Necessity Levels of Products

Basics

This section of the guide will attempt to give you an understanding on how to set reasonably balanced and realistic statistics for new products added to the game. To do this you will need to understand some of the basic parameters of products and what those parameters mean. The parameters that you change are as follows:

- Price
- Freight
- Demand
- Necessity
- Relative Price/Quality/Brand Weight (i.e. how important each of these factors are for determining demand relative to one another).
- Inputs (for example a Car requires a Car Body, Wheel and Tire, and an Engine to produce.

There are also other factors such as R&D, R&D Price Premium and obsolesce; the next section will discuss these factors in setting up products.

Each of these factors above will be briefly explained in terms of what they will do for the product in Capitalism Lab:

Price is the normal, default price that a product will normally sell for in the game if the quality rating is at 100 and Brand is at 0 and there are no competitors trying to undercut the price. In effect if these factors are in place then any attempt to make the price higher or lower will impact the demand for the product in retail/service stores or if it is a semi-product then it will impact the likelihood that Export clients or the AI (including the supply auto-link) will purchase the product (all of these factors are aggregated into the product's 'Rating').

It should be noted however that the actual price that a human or AI player will charge in game for the product will differ from the one set in the mod files due to the dynamic effects of price competition, inflation as well as branding and quality considerations so this price should only be understood as a baseline price.

One more important thing to note about price: Prices affect the inventory capacity and speed of factories, retail stores, farms, mines, etc. The higher the price, the slower the speed of production along with a smaller number of units that can be stored; this is why cars are produced very slowly and inventories cannot store more than a few at a time while for other products such as milk the production rate is fast and the inventories can store massive quantities of it.

Freight represents the cost of transporting the product relative to its price level, for example a freight level of 50 implies that up to 50% of the base cost of an item could be taken up by freight costs, although freight costs are also influenced by the distance (within and between the cities), the Freight Cost Modifier (in the Service DLC only) and the Freight Category cost index (Service DLC only).

Demand is the baseline willingness of consumers in a Retail or Service firm to purchase a particular product, for example a demand level of 1 means that each person in the city is expected to purchase 1 of this item per year on average, so in a city of 1 million people you can expect roughly 1 million annual sales of the product. In practice the actual demand for the product will vary depending on

the price, brand, quality as well as other factors such as necessity, whether it is a new invention or store type/coverage, so you should understand that the demand level is an approximate baseline.

In the case of semi products demand is irrelevant and it is set to 0. Any product with a demand of zero is treated by the game engine as a semi product (even if they are not in the semi product category).

Necessity is a modifier that changes the demand of a product based on the **Real Wage Rate** of a city, it is a simulation of the concept of **Income Elasticity of Demand** by which changes in consumer income can impact the demand for certain goods more than others.

For example Bread has a very high necessity index which means that even if the wage rate is very low the demand for bread will still be nearly as high as it would be for a city with a very high wage rate. In contrast having a low wage rate has a very strong impact on demand for Automobiles or Jewellery, given that both of these products have a very low necessity index (low income consumers are much less likely to buy these as they are typically luxuries).

Necessity is completely irrelevant for semi products and can be ignored for those product types.

Relative Price/Quality/Brand Weight determines the relative degree to which changes in the Price, Quality or Brand will impact a product's rating. For example certain products like Cigarettes have a very high brand rating but a very low quality/price rating which means that to get a high rating (and therefore high demand) for this product the player should heavily advertise. But for most electronics and software there is a high weight assigned to quality, which puts a strong emphasis on R&D and high quality inputs.

This trait has no relevance for semi products as all semi products have their ratings set by only price and quality (and the relative weights cannot be changed).

Inputs - With the exception of products derived from farms and natural resources all products will have 'Recipes' or inputs used to create that specific product. It is important that when setting prices that the prices of all inputs are taken into account as well; if the price of an input is changed this will affect the profit margin of all products further up in the supply chain so you should always be careful about changing the input prices.

Aside from prices there are two other traits to keep in mind regarding inputs:
Input Quality – this is the extent to which certain inputs will change the quality of the final product. For example 70% of a Car's quality is determined by the inputs (30% to the Engine and Car Body and 10% for the Wheel and Tire). The remaining 30% is assigned to R&D by default. It is permissible for inputs to have a 0% influence on quality; this is already the case with Software where the DVDs and Paper have no influence on the Software Quality, meaning 100% of software quality is based on R&D.

Note that inputs are set in the **Manufacturing.dbf** file, unlike the other traits above which are set in **Product_Types.dbf**.

Speed – in the Manufacturing.dbf you can set the speed of production. This figure is a percentage of the base speed and inventory capacity set by the product's price. If you set a higher speed the product will be produced faster and the inventory capacity will be larger. An example of this is the Engine, which produces twice as fast (Speed set to 200) and can have twice as much inventory capacity than what the engine's price would otherwise suggest.

Changing this may be useful for cases where the factories or farms have too much/too little inventory or speed for the price level of the product and you want to make it more realistic.

Profits and Mod Analysis Tool

Keeping mind the above concepts you can then calculate some important characteristics of a new or existing product, namely the amount of profit you can expect to make.

The two factors that are most important are the:

- Profit Margin
- Profit per Citizen

The **Profit Margin** is determined by the price of the product subtracted by the baseline input, production and freight costs. For example the profit margin of bread is the price the bread sells at minus the cost of flour (including freight), minus the bread's freight cost minus the cost of running the bread factory or to put it another way:

Profit Margin (PM) = Price (P) – Freight (FR) –Input Costs (IC) - Input Freight (IF) – Production Costs (PC)

This can be simplified as:
PM=P-FR-IC-IF-PC

That's quite a bit of math but don't worry; the Mod Analysis tool will do these rough calculations for you. Simply hold Alt-M in game and then select Analysis for the relevant product. Let's use the bread example to see how this works:

As you can see above it first works out the cost of all of the inputs. In the case of multiple inputs the tool will even factor in the relative size of each input (in the above example 2 pounds of flour costs $4 but it makes 5 loaves of bread so the actual cost per unit of bread is 80 cents, similar calculations are done for additional inputs).

It then takes into account the approximate cost of running the factory, using a medium sized factory with 5 units as the baseline and estimates the production levels. This is a very rough guide as it does not account for larger or smaller factories, training or the capital costs of building the factory in the first place.

It will then calculate the price of the item, including the R&D Premium (if applicable). After factoring in all of the costs it will then subtract it from it from the price, leaving you with the **Profit Margin**. In the above example the bread has a profit margin of over 50%, which means that for every dollar you spend making the bread you will earn a dollar in profit. It should be noted that this profit margin

does NOT account for the Freight Costs of the item, so as a general rule the profit margin should be higher for goods with a high freight index.

It should be noted that the above calculation does not necessarily imply that bread is profitable, if the demand is very low then it might not be worth the capital and inventory costs. The true determiner of profitability is the **Profit per Citizen** which is the above example is calculated by multiplying the number of expected sales for each citizen per year and multiplying by the profit per unit. The **Sales per Citizen** would determine the amount of revenue for this product.

In this case the amount of profit per citizen is $20, so in a city of 500,000 this would imply an annual profit of $10 million. Again, this is a very rough estimate; you would need to factor in the changes in price, quality, branding, price competition, etc., all of which would change the final figure. This also excludes another important factor: the **Profit Margin of the Inputs** or The Vertical Integration Factor.

The profitability of the bread is also determined by the potential profit margin you can earn on the flour as well:

In the above example the flour has a nearly 50% profit margin and so if a company has their own supply of flour then the profitability of bread is also higher as part of the input costs are actually profits for the supplier as well (the same goes for the flour factory purchasing wheat). Of course if the company buys flour from another company or the seaport than they miss out on those extra profits.

This means that when calculating the profit margin of bread it is probably closer to 75% than 50% in practical terms.

Special Rules concerning in game prices

Prices in the game will also have some special rules that you should know about.

Raw Material Prices

Raw Material prices are influenced by the following factors:

- The base line price set in the Product_Types.dbf file
- The price (RES_COST) set in Natural_Resources.dbf

For example in the unmodded game the price of Gold is set to $1000 per ounce and in the Natural Resources file the RES_COST is set to 50. What this means is that if you construct a Gold Mine than the price of extracting Gold will be $500 per ounce (assuming a quality rating of 100 and no natural resource price premium) and as a result the mine owner will make $500 for each Ounce of gold they sell.

However it should also be noted that Natural Resources have land costs associated with them (the cost to buy the site). The land cost is determined by the following factors:

- Real Wage Rate of the city.
- The quantity of resources per site (this is determined by RES_QTY). More resources will not affect per unit cost of production but they do affect the initial purchase price.
- The quality of the resources at the site. A quality of 50 is half the price of 100. Quality also affects per unit production costs.
- The price premium (if too many resources relative to the total available are being purchased the price will normally jump by a certain percentage).
- The number of different products that can be derived from this raw material (for example Lithium is very cheap as only one product can be made from it but Chemical Minerals are expensive as lots of products use this raw material). In addition this might also be affected by the profitability of the upstream products as well.
- Land Cost Index (in the CES DLC).

Crop and Livestock Prices

The default selling price of crops and livestock is determined by a fraction of the price set in **Product_Types.dbf** with adjustments made for the quality as well as the variety of products that can be derived from these products (for example Flax and Rubber crops sell for different prices on the farm despite having identical baseline prices and the reason why is that rubber has more uses than Flax).

The cost of the Livestock and Crop products on the farm itself appears to be calculated based on the costs of the running the Cattle Raising and Processing Units (or the Crop units) and so the unit cost can fluctuate for these resources.

R&D Premium

According to the Modding Guide on the Capitalism Lab this is:

This is the component of the product price that is NOT affected by inflation nor wage rates.
For example, Smart Phone's PRICE is 600 and RD_PREMIUM is 200. Its standard selling price would be 600+200 = 800. The core component of the total price (600) will go up over time with inflation and

is also affected by the wage rate of the city where the product is being sold. On the other, the R&D Premium price component (200) is not affected by inflation nor wage rates.

This setting explains why prices of smart phones are partially decoupled from inflation as they require constant investment in R&D. The technological leaps add tremendous values to the products while keeping the production costs in check.

So what this means is that if inflation is switched on the rating of the product will tend to decline over time if the price of the product keeps rising in line with inflation. For example a CPU has a $100 base price and a $200 R&D Price for a total of $300. So over time the rating of the CPU will decline if its price is set to increase with the inflation rate. In the case of inflation inversion the rating will decline over time if the price remains exactly the same.

The above case is for both semi products and retail products. In the case of retail products the R&D Price Component is also decoupled from the wage rate of the city so that necessity has no effect that part of the price component (this is part of the reason for example why Smart Phones are very popular even in low wage rate cities).

Best Practices

Setting the right levels for demand, price, necessity, freight, etc. is more of an art and not a science so this advice is very general and not applicable in all cases.

As a general rule your products should adhere to the following principles in terms of statistics and inputs:

- Realistic
- Reasonably profitable
- Balanced and Fun

I will explain each principle:

Realistic

When adding a new product to the game it should, as much as possible adhere to the real world aspects of that product. For example you should do some research into the product you intend to create to verify the following:

- What is it made from? Do these materials already exist in the game or do you need to make new semi products/raw materials/crops/livestock? For example if you want to create Apple Cider you will probably need to add Apple crops to the game. But if you are creating T-Shirts then Cotton and Dyestuff should be enough as inputs. Make sure that you do some research to avoid embarrassing errors in this regard (and be mindful of the units involved such as pounds, kilograms, etc.). In the case of fantasy or futuristic products that don't exist in the real world such as those in Magitek or Future World you should use your imagination but always maintain reasonable consistency in terms of how your fantasy products work (for example in Magitek Spectral Sunflowers are always associated with invisibility themed products, Liquefied Mana is only used for Potions or Beverages, etc.).

- What is the real world demand for this product? This is another area you will need to do research in and to take some educated guesses. For example you could look up the product online and look at the annual number of sales within a certain country and then look at the total population of that country to get a rough estimate on the product's demand. You could also look at similar products in the game and set the demand level to be similar to closely related products. In the case of non-real

world products you will once again have to use your imagination, for example in Magitek magical wands are sold as consumer items, I imagine that in a world of real, functional magic everyone will want at least one wand (and some wands are expected to break or wear out especially if they are cheap) so the demand for the cheapest wand is set at roughly 1 per citizen, per year while more fancy and prestigious wands have a demand much lower than that.

- Is this product a real world necessity or not? Similar to demand you should also set a reasonable level of necessity for the product as well. To get a feel for this you may need to do some comparative research. For example looking up how popular a product is among certain consumers (like those on minimum wage vs high earners) or in certain countries (such as the United States vs Bangladesh). In the case of non-real world products you will have to do some reasonable speculation.

- What is the real world cost to transport or handle this item in inventories? To set an appropriate Product Freight Cost you should research the real world transport and inventory costs of the product. For example certain products such as small electronics, watches and jewellery have very low freight costs relative to their production price due to being small and lightweight while other products like food and beverages have very high freight costs relative to their production price. You should also be mindful of historical or geographical factors, for example if you have a mod that simulates capitalism in 1900 then freight costs are likely to be higher than in the year 1990.

Reasonably Profitable

As a general rule once you have set the level of demand and the materials you should then set a price for the item to reflect a reasonable profit margin. When setting a profit margin you should consider the following factors:

- Freight Costs, if freight costs are high than profit margins should automatically be higher to make up for potentially expensive transport and inventory costs (which are not factored into the Mod Analysis Tool).
- Number of Inputs – if a product requires a lot of different inputs and those inputs require their own inputs than the profit margin should be higher as it will take more investment to get all of the required inputs (i.e. the difference between making Bread from Flour vs making Cookies from Flour, Sugar and Cocoa).
- Diversity of Inputs in other products – If a product is made from a semi product or a farm product then you should consider the possibility of using those inputs in other products. For example if you have two products made from (only) Apples than the profit margin for both should lower than if only one product was derived from Apples and the reason why is that if I own an Apple Farm then it is very easy for me to create both products without extra investment, hence for balance the potential profit should be reduced.
- Profitability of inputs – In general if the semi products of an end product have a high profitability you should set either a lower profit margin for the semi products or for the final end product. For example Cars and Electric Cars have a relatively low profit margin compared to most products; however in practice the profit margin in game is much higher as the semi products such as the Car Body and Engine have a very high amount of profit per unit, which strongly encourages vertical integration and makes this product very profitable.
- R&D and Obsolesce factors – Generally speaking if a product can be quickly made obsolete by another product (for example Mobile Phones very quickly go obsolete as Camera Phones usually don't take long to invent) then the profitability of that product should be increased so that there is a reasonable incentive to actually produce it and profit before it goes obsolete.

On a final note about profitability try to avoid having profit margins lower than 20% to 30% for any product in general, otherwise it might not be worth investing in even if all of the other factors are favourable.

Balanced and Fun

In general the above rules should also keep in mind the bigger picture, which is to make sure that the products are fun and enjoyable to do business with. In general you should follow a few general rules in that regard:

- Don't make supply chains too complicated or hard to understand unless you are building a mod focused on supply chain complexity.
- Don't make tech trees complicated; for example a player should not need to research several new techs that are serially dependent on one another (Tech 5 can only be searched after Tech 4, which requires you to research Tech 3, etc.).
- Make sure that product names are sensibly named, including their inputs and pictures to avoid confusing players.
- Avoid creating nearly identical products unless this is your mod's central theme (such as the Auto Empire Mod). For example creating cans of Soda which are nearly identical (Cola, Lemon Flavoured Cola, Vanilla Cola, etc.). However even if nearly identical products are central to your mod you should probably stick to a small number of categories to avoid overwhelming and confusing players.
- Make sure that the AI competitors have the appropriate product statistics that allow them to make intelligent product decisions. Some things to keep in mind are TECH_IMPT for semi products as well as the Semi Product Megaclass (useful if you have multiple semi product categories such as in Magitek or Future World).

Product R&D and Obsolesce

In Capitalism Lab you may set a product as requiring invention either as a standalone product or by researching prerequisite technologies (including the invention of other products). You can set the following scenarios for product R&D:

- Product is available at the start of the game and does not need any R&D unless Random Product Reinvention or Survival Mode is on.
- Product needs R&D and can be immediately researched at the start of the game (for example the Camera Phone).
- Product needs R&D but the product is only available to be researched after a certain year (for example the Portable Media Player is only available after 2000).
- Product needs one or more technologies to be researched before it is invented (i.e. Software, Internet Companies or Product Tech).
- Product needs another product to be researched before it can be researched (for example a Smart Phone or Electric Car). Please note that if a semi product used as an input in another product needs to be invented then that product cannot be researched until the semi product has been researched (for example you cannot invent the Electric Car until you have invented the Electric Car Chassis, even if you can buy an Electric Car Chassis from a competitor's factory).
- Some combination of the above.

Given the above scenarios then which of these product scenarios you choose will be up to you. Some principles to keep in mind are:

- Make sure that the product and semi product invention dates are correct for the time period, for example while Electric Cars have existed in some form since the late 19th century, modern consumer grade electric cars were not developed until the 2000's due mostly to advances in battery technology. If your product is fictional or speculative then try to set a realistic invention date based on related technologies or reasonable speculation.

- Make sure that the time allocated to research new products is reasonable, especially in relation to the profitability of the final product. For example the Smart Phone is an extremely lucrative and profitable product; this is in part due to the massive amount of time and money it takes to R&D and the intermediate technology to get there (the Camera Phone).

- It should also be remembered that companies gain an advantage by being the first to research a new technology, the amount of money earned from the temporary monopoly on the product until the time that competitors catch up is in economics terminology known as **Schumpeterian rent**. There is also an additional demand boost when the product renders another obsolete (i.e. a Smart Phone will rapidly steal market share from a Camera Phone, disadvantaging anyone who cannot keep up technologically). All of this should be kept in mind when setting the demand/profit of products.

Product Tech vs R&D of Products

In Capitalism Lab there is a modding feature called Product Tech which is not used for any products in the base game but is available for any modder to use. In this case instead of inventing a product directly you can research 1-3 technologies to unlock a product by using Tech R&D Units instead of product R&D units (the same units used to research Internet Company techs).

I will briefly list the different reasons you may want to choose one path over the other and what gameplay impacts this choice may have:

Product Tech can be a useful way to increase the amount of investment a player must make to unlock a product – for example instead of performing an R&D of a single product you must research more than one tech at once (such as Touch Screens and SIM Cards for a Smart Phone). If you choose to do this than make sure that the product has a profit level worth all of that investment.

Another advantage is that you can use it as a means of inventing multiple products at the same time. For example if you have four similar products you could have all of them invented simultaneously based on one common technology (for example Cake Tech unlocking all possible cake types). Be sure to set the profit margins appropriately if so.

You could also use this to group products together and set the player down a particular path, for example by setting a SIM Card tech this could allow you to partly unlock mobile phone related products even if a different tech might be required for each generation of phone.

There are some drawbacks to using Product Tech however:

- Many new players may get confused as to how this works, since this is not a base game feature.
- In the R&D buildings the skills and training used for the tech units are not transferrable to other techs. In contrast for product techs the skills are transferrable to any product in the same category (for example if you have trained your R&D staff to skill 100 for Camera Phones you can easily switch to Smart Phones if you want, giving you a head start in the tech race, if you don't like the idea of giving players a head-start like this then Product Tech is a perfect way to prevent this).
- Tech ignores the Technological Disruption difficulty setting.
- You can only use this feature in the Digital DLC.

For instructions on to implement Product Tech see the following:
https://www.capitalismlab.com/mod/modding-dlc-features/modding-technologies/

For general information on how to mod new techs see this article:
https://www.capitalismlab.com/mod/modding-dlc-features/modding-technologies/

It should be noted that this section is inaccurate:

CANINV_YR	Numeric	0 OR 1990 to 2999	This field currently has no effects in the game. It is reserved for future use.
PARENT1	Character	10 chars	Reserved for future use.
PARENT1_LV	Numeric	0 to 9999	Reserved for future use.
PARENT2	Character	10 chars	Reserved for future use.
PARENT2_LV	Numeric	0 to 9999	Reserved for future uses.

You can actually set a year for techs to be invented after (CANINV_VR) and it will actually work. Likewise PARENT1 and PARENT2 set prerequisite techs and PARENT_LV will set the tech threshold of the parent techs to be considered 'Invented' (for example you could have a rule: to start researching Space Flight you must R&D Rocketry to a level of 100).

Passive Obsolesce

It is also possible to set the demand of a product to decrease over time via the OBSOLETE parameter. In the base game this is used to simulate the reduction of demand for Cigarettes and Cigars over time from public health campaigns, however you can use this feature to simulate the passive decrease in the demand of anything you want. In this case it should be noted that the

demand will never fall to zero (for example Cigarettes will decline in demand by 2% each year, but since this is an exponential decay the Cigarette demand after 50 years will be roughly 36% of the original value).

If you need to test if this works in game, you can open the Mod Analysis tool and then look at the Demand per Citizen; over time it will decrease and then it will re-calculate the new revenue/profit per citizen, giving you an idea on how much the long term profitability of the product is being affected.

This feature also works for newly invented products as well, for example if you add a new product, say an E-Cigarette that needs to be invented and set a number for OBSOLETE then the demand decline will only start after the product is first invented.

Overall Gameplay Balance

When you mod items into the game it will have an effect on the normal balance of the game. This is due to the dynamic and interactive economic model used by the Capitalism Lab engine being affected by all of the choices made by the human and AI players as well as the various city governments, the Central Bank, etc.

If you have ever played mods such as the RealWorld or ModernWorld you may have noticed that they tend to have unintended effects on gameplay. In general some of these effects are:

- It tends to be much easier to make money for both human and AI players for a variety of different industries.
- The economy grows much faster for long periods of time and recessions tend to be rarer and less intense than in normal base games.
- There are a lot more farms, factories and stores and empty land to building new things may start to run out. In addition the game tends to run slower.
- The city populations tend to grow to higher levels.
- Cities rarely go bankrupt/have fewer revenue problems than in the base game despite providing more services to bigger populations.
- Inflation and Central Bank interest rates tend to be higher for longer periods of time.
- Natural Resource sites tend to be a lot more expensive.

All of these effects are related to one another and stem from what happens when you start adding new products/firms/etc. to the game.

To understand this better let's consider a very simple example; adding a single new product such as **Hot Dog Rolls** and let's make it have the following characteristics:

Input: Flour
Price: 2.5
Demand: 10 per citizen
Profit Margin 40%

In this example the product will be an item that can now be sold in a store and as a result in a city of 500,000 citizens it will have 5 million annual sales at a price of 2.5, leading to the total annual revenue being 12.5 million. At a 40% profit margin a company can be expected to make approximately $5 million in profit.

So we can already see that this will affect the game's dynamic model, for example this will also add $12.5 million to the Consumption component of the city's GDP and $5 million of annual profit between all companies that produce this item (less if price competition is factored in).

So we can already see that the economy and profitability of companies has been boosted thanks to just adding this one item. However there is more to it than just that.

When you add a new item a new production and R&D facility needs to be added, along with a farm/natural resource firm (these firms are duplicated if there are multiple companies selling the same product). In this specific example the demand for flour will increase, probably requiring more and larger Flour Factories and more Wheat from farms. This increases the investment component of the city GDP to pay for the buildings and the workers.

This then has knock-on effects for the broader economy as all the new workers making Hot Dogs will be customers for other products, increasing their demand and thereby necessitating more investment to keep up with the increased demand along with greater profits and city tax revenues on consumption/profit. This means that even if a company isn't in the Food Industry, it still benefits from a new food item due to the second-order effects.

When you keep adding items to your mod this effect snowballs and becomes bigger and bigger, leading to a lot more economic growth and all-round corporate profits beyond the levels you will see in the base game. However this does lead to a lot of problems with land running out and the economy almost never getting a recession as well as high inflation and interest rates. Overall the result is that the game gets less challenging.

Are there any ways to mitigate these problems? The answer is to some extent, yes. Here is some advice:

- Reduce the profitability of base game products, along with your new products, especially if the products all have common inputs. For example in the Hot Dog Buns example above you could reduce the impact by reducing the price or demand of all Flour based products (Bread, Burger Buns, Cakes, etc.) in order to reduce the Profit Margins/Consumption GDP component. This will also help to make the game more challenging as it is harder to make money and expand.
- Increase the number of products that need to be invented via R&D and/or stretch out the research times of the new products so that large numbers of new products are not sold on the market too early in the game (i.e. give the economy time to slow down before new inventions speed it up again). Eventually the economy will still become very large over time as all of the products are invented, but the annual GDP Growth over that time will be slower and there will be more boom/bust cycles.
- Add new firms to the game with higher capacities such as bigger farms/factories/apartments/commercial buildings. This reduces the amount of space on the map these firms take up as you don't need to build as many. You can also try raising the maintenance and construction costs of all firms to reduce overall company profitability.
- In the case of Natural Resources, the problem of expensive Natural Resource sites can be mitigated either by reducing the number of products derived from that natural resource or alternatively by reducing the RES_QTY of the natural resources which are too expensive. The latter solution will cause the resources to run out faster however (which may unfortunately be unavoidable unless you play with Unlimited Natural Resources switched on).

You can also send this advice to anyone that plays your mod:
- Play with the Competitor Price Aggressiveness difficulty at a higher level (to reduce everyone's profit margins via stronger competition).
- Play with Shopping Malls, Apartment/Commercial Buildings with Retail Space and Multiple Floors = Yes (to save space on the map). Note that these options require the Subsidiary and Service DLCs.
- Play with multiple cities or fewer competitors if space is a problem.
- Increase the Public Expenses Modifier in the CES DLC to reduce the surplus amount of money on city balance sheets and keep taxes higher/services fewer. This slows the economy down to some extent.
- Increase the Global Competitiveness Rating Increases in the City CES Settings to reduce the export component of GDP growth.
- Increase the Apartment/Commercial Buildings Capacity to reduce the number of buildings on the map and to reduce the profitability of Real Estate companies (or you could increase the capacity yourself so the player does not have to).

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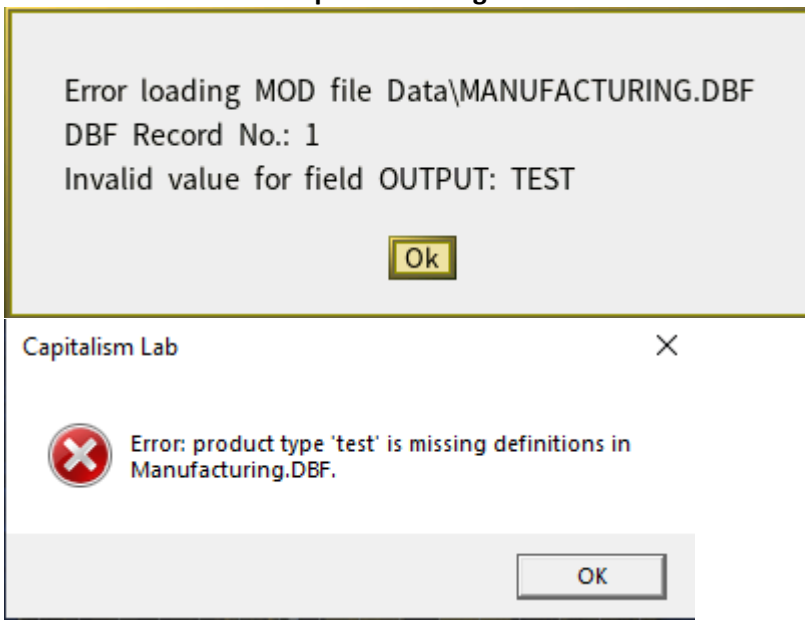
None of the above measures will fully mitigate the problem however so you should experiment and test to see what the right balance is.

Common Errors and other problems

When developing your mod you may encounter errors, unexpected behaviour or things just don't work the way you intended. This is a list of common problems encountered in modding which you can fix or work around. Hopefully this will save you a lot of time and frustration as well as saving the time of Enlight's staff from having to troubleshoot custom mods:

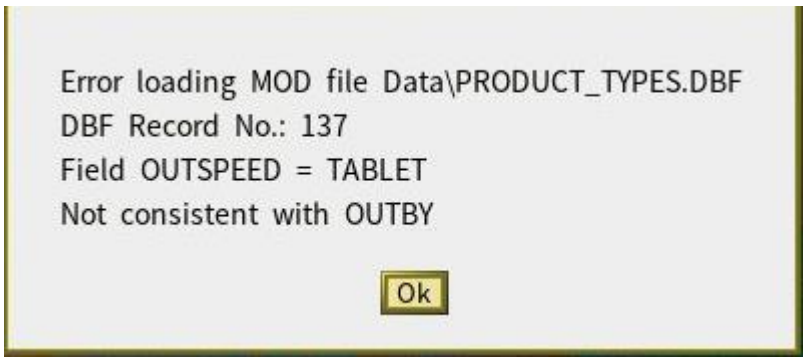
Errors

Invalid value for field Output or missing definition in Manufacturing:



This happened because you added something to **Manufacturing.dbf** and not **Product_Types.dbf** (or the other way around). Make sure that the product is in both of these files and that the product code is spelled consistently in both files.

OUTSPEED is not consistent with OUTBY



This means that you have set a product code in OUTBY but you did not set an OUTSPEED (and so the product won't go obsolete). Note that this error might not appear in all versions of Capitalism Lab, in which case it will 'Silently' fail; more on this issue under the **Changes not working** section.

Changes not working

Image problems

Images are not appearing after adding them to the required folder
For example you have added an image to the Software folder; however the in game image does not appear for that software product. There is no error message.

Possible Solution: For some of the folders the **PACKALL.bat** command you normally use to build your entire mod may miss certain folders (I don't know exactly why). If this happens to you just run the local folder **pack** file, for example in the Software folder if you run **pack.bat** and then go back and run **PACKALL.bat** again your software image should appear in game. A similar solution can be used for other folders where this problem may appear such as in **Internet_Companies** and **Buildings**. Same rule applies in the products folder for the very small product images (i.e. run **make_small_images.bat** after you add or change an image in products).

Other Solutions: Check the image file spelling (make sure it is the code name of the product such as 'BAG' not 'Leather Handbag'). Make sure images for products and software are 120 by 120 pixels.

My building images look weird (for instance showing a large white background in game)
This is probably due to the way you saved the .png for the building images. Make sure you follow these instructions carefully in the mod article:
https://www.capitalismlab.com/mod/advanced-modding/advanced-modding-buildings/

a) The file must be in PNG 32 bit format (24 bits of RGB values + 8 bits of Alpha channel).
b) The size of the image cannot exceed 1024×768.
c) The background should be defined in the Alpha channel. (If you are not familiar with the alpha channel, you may read this introductory article: http://asktimgrey.com/2017/11/27/what-is-an-alpha-channel/)

Basically in Paint.NET I save the image as a PNG, but if I save it using normal Windows Paint I get the ugly white background effect (because MS Paint does not save transparent PNGs).

Products are not going obsolete

For example you have Product A then you R&D Product B but product A does not decrease its level of demand.

A couple of reasons this happens:
- You set an OUTBY but did not set an OUTSPEED in **Product_Types.dbf**, as a result the game will simply ignore the error and not make the product go obsolete.
- You set the OUTBY to the wrong product or even the same code as the product being made obsolete (i.e. making a Mobile Phone go obsolete by a Mobile Phone, in which case the game simply ignores it and does nothing).

DLC Compatibility

Currently Capitalism Lab has the following DLCs that you can run:

- Base Game (No DLCs)
- Subsidiary DLC
- City Economic Simulator (CES) DLC.
- Digital Age DLC
- Banking and Finance DLC
- Service DLC

This section will explain what effect each of these DLCs may have on your mod, in which case you can then decide if you want certain DLCs to be required for playing your mod (or not).

Base Game

This is Capitalism Lab with all DLCs turned off. This means no player banks, service firms, shopping malls, software/internet products, government mode, etc. It should be noted that no matter what things you add into your mod (Service Firms, Digital Products) the mod can still be compatible with the base game.

If you have Digital Products then in the base game they won't appear.
If you have service firms than the service firms and their products still appear, however they will be converted to retail stores instead (the service products will have to be produced in factories instead). See Step 3 in this guide for how to do this: https://www.capitalismlab.com/mod/modding-dlc-features/modding-service-firms/

Subsidiary DLC

The Subsidiary DLC does not add any new products or firms of any kind however there are two features worth considering:

- Multiple Retail Floors
- Fine-tuned Subsidiary control

Multiple Retail Floors are very useful in mods with lots of products in them, if this feature is not enabled the map can fill up much more quickly as more stores are required.

In addition in mods with overwhelming numbers of products and product categories the ability to direct Subsidiary corporations to produce in certain product categories can be a very useful division of labour for players that want to build a big sprawling business empire in every category.

In general I would recommend that this DLC not be made a requirement for running your mod to maximise the potential number of users, but players with the DLC should be encouraged to use it while playing with your mod.

City Economic Simulator (CES) DLC

This DLC introduces quite a few changes:

- A more sophisticated economic model involving the interaction of city governments as well as other concepts such as city exports, quality of life, etc.
- The ability to control the government.
- The ability to control certain business environment or policy levers such as taxes, land values, real estate capacity, etc.

As far as modding goes the results are mixed:

- If you can control the government of the city you can move firms on the map around and create/demolish roads, potentially allowing players to free up some space on the map.
- By setting a high level of public expenses, high land expenses or high real estate capacity you can slow down economic growth (see Overall Gameplay Balance for further details on why you may want to do that).

But also government buildings also take up space on the map and as cities grow larger the government builds more of them, something they don't do in the base game.

In general I would recommend that this DLC not be made a requirement for running your mod to maximise the potential number of users, but players with the DLC should be encouraged to use it while playing with your mod.

Digital Age DLC
The Digital Age DLC adds various new firms and products to the game. If you do not enable Digital DLC than any new products you have modded into the game in this DLC will not appear at all. This may affect the balance of the game in unforeseen ways (for example fewer products will slow economic growth and a lack of Internet Advertising firms will make Media Firms extremely lucrative as they are the only way to advertise).

You should also take into account that the Digital DLC also introduces the concept of a limited pool of talent for researching products and tech. As a result you should advise players to increase the amount of talent in the game if you have a lot of products.

In general I would recommend that this DLC only be made a requirement for your mod if digital products are a big focus of your mod. If you are creating a historical mod that predates digital technology it may even be worthwhile to discourage users from running this DLC.

Banking and Finance DLC
The new firms added in the Banking and Finance DLC cannot be changed in modding at this time. The only things you can change are the stocks used in the Global Stock Market. If this DLC is not enabled then the stocks you add or remove from the Global Stock Market are completely irrelevant.

In general I would recommend that this DLC not be made a requirement for running your mod to maximise the potential number of users, whether users run this DLC or not with your mod probably won't matter that much.

Service DLC
The Service DLC adds the following new features to the game:

- Import/Export Companies
- Logistics Firms
- Shopping Malls
- Service firms

All of these can have a large effect on your mod. Shopping Malls for example will help to save space in mods with lots of products, Import/Export companies will in general tend to encourage economic activity, boosting economic growth (although the boost is limited due to the fact that the

import/export companies have limits as to how many products can be exported/imported no matter how many products are in your mod).

And Service Firms can be optionally added to your mod depending on the Mod Kit that you use. However you can in theory have Service Firm products sold in retails stores if this DLC is disabled.

Logistics firms will tend to be more profitable in modded games than the base game due to the greater number of products providing larger economies of scale.

In general I would recommend that this DLC not be made a requirement for running your mod to maximise the potential number of users, but players with the DLC should be strongly encouraged to use it while playing with your mod (unless you are not using Service Firms at all in your mod).

Testing your Mod

This section will explain some of the main things you should test and check before publishing your mod along with some tools and scripts that can aid the process.

General Testing Advice

In general it may be worthwhile to keep in mind the following principles when testing:

- Make sure you test the game several times with different difficulty settings and different business environments.
- If you intend to make your mod compatible with a certain set of DLCs then make sure that you test it with that combination of DLCs.
- Make sure that all products work correctly and that the AI players are able to research and sell these products without problems.
- Test a variety of different products and product categories. Check if any seem unbalanced (i.e. too profitable or not profitable enough).

Testing Checklist

Note: This checklist excludes anything that will automatically cause an error if you fail to add it. The checklist below is only for things that are not automatically checked by the game's engine (and therefore easily possible to miss).

Products

Do all of your new/altered products have the following?

- A Product Image (including a small Firm Image)
- Images look correct (not too large/small or badly proportioned)
- Level of Profit for the products is above zero

Special:
- Service Firm Prepare Image (if this is a Service Firm Product)
- Livestock Raising/Processing Image (if applicable)

Firms

Do your new/altered firms have the following?

- Does your firm's image look correct at all zoom levels? Make sure you test all zoom levels and check if the firm's image looks okay in the context of surrounding buildings (i.e. try to be consistent with the game's art style).
- All Retail and Service firms should have at least one Firm Image (image shown of the firm's interior)
- (If a service firm) – can the service products also be sold in retail stores if Service Firms = No?

Special

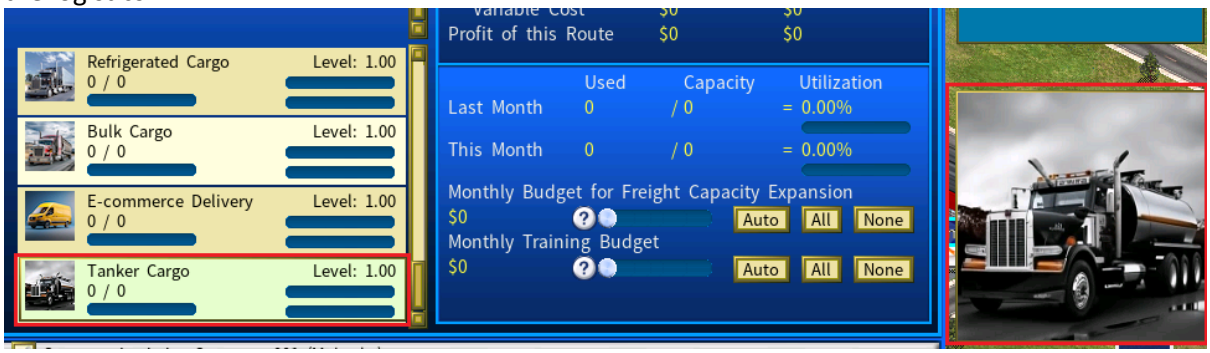
- Does your internet company have a banner image? If it is an Advertising firm does it also have an icon image (appears when selecting a media firm to advertise a product with)? Example:

Internet Banner Image:

Internet Icon Image:

Freight Category

If you added a new freight category check that it also has a large and small image that will display in the logistics firm:



Tech

- Do all of your new techs connect to an Internet Company, Product (via Product Tech) or Software? Make sure you don't have any 'Orphan' techs that don't do anything.
- Do all new techs have tech images? See example below:

Test Tools

There are two tools that you can use to make your testing easier. These tools are the use of Scripts and the Mod Analysis Tool.

Scripts

Scripts are used in Capitalism Lab to set the difficulty level at the start of the game along with other settings (such as the goals, number of cities, special rules, etc.). To properly test your mod you should have a few scripts handy with difficult settings to test certain things like the difficulty level, high the AI reacts to your mod and anything else. To this end I have put together a couple of scripts you can use:

NOTE: Make sure you substitute the name and description of your mod in the areas highlighted in red. Feel free to also tweak the script for any other changes you want:

Script 1

[HEADER]
Title= MODNAME Test, Sandbox mode
Description=This is a sandbox test, which has no AI Competitors to disturb you
Reset All Settings=Yes
MOD=MODNAME,Global

[ENVIRONMENT]
Number of Cities=1
Your Start-up Capital=Very High
Random Events=Never
Game Starting Year=1990
Retail Store Type=Many
Technology Disruption=Yes
Stock Market=Yes
Alternative Stock Sim=Yes
Inflation=Inverse
Retail Store Floors=Multiple
Boom-Bust Cycle Volatility=Moderate

[COMPETITORS]
Number of Competitors=0

[DIGITAL AGE DLC]
E-Commerce=Yes
Talent System=Greatly Simplified
More Talents=500
Disable AI Digital Companies=Yes
Max E-Commerce Share=Very High

[Banking and Finance DLC]
Feature Bank=Yes
Feature Bond=Yes
Feature Insurance=Yes
Insurance Claims=Low
Feature Global Stock=Yes
Realistic Money Supply=Yes
Warehouse Floors=Multiple
Acquire Companies Facing Bankruptcy=No
Realistic Loan Demand=Yes

[Experimental DLC]
Built-in Advertising Unit=Yes
Farm Extension=Yes

[SERVICE INDUSTRY DLC]
Service Firms=Yes
Shopping Mall=Yes
Logistics Company=Yes

Apartment and Commercial Buildings Have Retail Space=Yes

Script 2

[HEADER]
Title= MODNAME Test, moderate difficulty
Description=Moderately expansionistic AI players, designed to simulate a medium difficulty game.
Reset All Settings=Yes
MOD=MODNAME,Global

[ENVIRONMENT]
Number of Cities=5
Your Start-up Capital=Very High
Random Events=Never
Game Starting Year=1990
Retail Store Type=Many
Technology Disruption=Yes
Stock Market=Yes
Alternative Stock Sim=Yes
Inflation=Inverse
Retail Store Floors=Multiple
Boom-Bust Cycle Volatility=Moderate

[COMPETITORS]
Number of Competitors=30
Competitor Start-up Capital=High
AI Expansion Aggressiveness=Moderate
AI Pricing Aggressiveness=High
AI Expertise Level= Moderate
Show Competitor Trade Secrets=Yes
Competence of Local Competitors= Moderate

[DIGITAL AGE DLC]
E-Commerce=Yes
Talent System=Greatly Simplified
More Talents=500
Max E-Commerce Share=Very High

[Banking and Finance DLC]
Feature Bank=Yes
Feature Bond=Yes
Feature Insurance=Yes
Insurance Claims=Low
Feature Global Stock=Yes
Realistic Money Supply=Yes
Warehouse Floors=Multiple
Acquire Companies Facing Bankruptcy=No
Realistic Loan Demand=Yes

[Experimental DLC]
Built-in Advertising Unit=Yes
Farm Extension=Yes

[SERVICE INDUSTRY DLC]
Service Firms=Yes
Shopping Mall=Yes
Logistics Company=Yes
Apartment and Commercial Buildings Have Retail Space=Yes

Script 3

[HEADER]
Title= MODNAME Test, high difficulty
Description=Highly aggressive and difficult AI players.
Reset All Settings=Yes
MOD=MODNAME,Global

[ENVIRONMENT]
Number of Cities=5
Your Start-up Capital=Very High
Random Events=Never
Game Starting Year=1990
Retail Store Type=Many
Technology Disruption=Yes
Stock Market=Yes
Alternative Stock Sim=Yes
Inflation=Inverse
Retail Store Floors=Multiple
Boom-Bust Cycle Volatility=Moderate

[COMPETITORS]
Number of Competitors=50
Competitor Start-up Capital=Very High
AI Expansion Aggressiveness=Very High
AI Pricing Aggressiveness=High
AI Expertise Level= High
Show Competitor Trade Secrets=Yes
Competence of Local Competitors=Very High

[DIGITAL AGE DLC]
E-Commerce=Yes
Talent System=Greatly Simplified
More Talents=500
Max E-Commerce Share=Very High

[Banking and Finance DLC]
Feature Bank=Yes
Feature Bond=Yes
Feature Insurance=Yes
Insurance Claims=Low
Feature Global Stock=Yes
Realistic Money Supply=Yes
Warehouse Floors=Multiple
Acquire Companies Facing Bankruptcy=No
Realistic Loan Demand=Yes

[Experimental DLC]
Built-in Advertising Unit=Yes
Farm Extension=Yes

[SERVICE INDUSTRY DLC]
Service Firms=Yes
Shopping Mall=Yes
Logistics Company=Yes
Apartment and Commercial Buildings Have Retail Space=Yes

Creative Ideas for a new Mod

Given the knowledge you now have of mods are some existing mods that can serve as sources of inspiration (and why) along with some mod ideas that have yet to be explored for Capitalism Lab.

Observation of Existing Mods

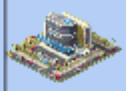
The following mods I have found most interesting in terms of how they creatively use the Capitalism Lab engine to their advantage:

RealWorld is one of the most popular and widely used mods in Capitalism Lab as it attempts to simulate the very complex and detailed world of Capitalism and the variety of products and inputs as accurately to Real Life as reasonably possible. Aside from being a widely played mod RealWorld also has its source available publically, so you can look at the original files and see how it does what it does 'Under the Hood', which may be very helpful if you have ever wanted to find out how certain mod tricks are performed.

An example of the **Product_Type.dbf** file from the RealWorld mod source:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	CLASS,C,8	CODE,C,8	NAME,C,21	PRICE	RD_	FRE	UNIT,C	UNITS,C	DEMA	NI	PR	QU	BR	CANINV	INV	TE	IM
2	ALCOHOL	BEER	Beer	1	0	15			16	6	25	40	35	1910	0	0	
3	ALCOHOL	LIQUEUR	Bottled Liquor	17	0	25			1.7	1	25	25	50	0	0	0	
4	ALCOHOL	BRANDY	Brandy	25	0	18			1	1	20	40	40	1922	0	0	
5	ALCOHOL	WINE	Red Wine	15	0	25			12	4	20	40	40	0	0	0	
6	ALCOHOL	RHUM	Rhum	9	0	18			2	1	20	40	40	1906	0	0	
7	ALCOHOL	SCHNAP	Schnapps	20	0	22			0.9	1	10	45	45	1937	0	0	
8	ALCOHOL	SPARK	Sparkling Wine	30	0	25			3.2	2	10	30	60	0	0	0	
9	ALCOHOL	VERMOUTH	Vermouth	12	0	30			1	2	30	35	35	0	0	0	
10	ALCOHOL	VODKA	Vodka Lemon	37	0	20			1	1	20	35	45	1930	0	0	
11	ALCOHOL	WHISKY	Whisky	35	0	20			2.2	1	20	30	50	0	0	0	
12	ALCOHOL	WHWINE	White Wine	17	0	25			7.5	2	20	35	45	0	0	0	
13	APPAREL	BABYCL	Baby Clothes	15	0	10			1.95	4	35	35	30	0	0	0	
14	APPAREL	CAPS	Baseball Caps	6	0	4			6.9	2	30	25	45	0	0	0	
15	APPAREL	BATHROBE	Bath Robe	20	0	10			1.4	1	40	35	25	0	0	0	
16	APPAREL	BLAZER	Blazer	200	0	10			0.7	4	30	35	35	0	0	0	
17	APPAREL	BOXRSHRT	Boxer Shorts	12	0	10			1	5	30	30	40	0	0	0	
18	APPAREL	CASHSWET	Cashmere Sweater	80	0	8			0.6	2	20	40	40	0	0	0	
19	APPAREL	DRESSPA	Dress Pants	55	0	10	pair		3	4	30	30	40	0	0	0	
20	APPAREL	FUR_COAT	Fur Coat	200	0	12			0.3	1	20	50	30	0	0	0	
21	APPAREL	JEAN	Jeans	40	0	10	pair		6.5	6	25	30	45	1920	0	0	
22	APPAREL	JACKET	Leather Jacket	200	0	11			1	3	30	35	35	0	0	0	
23	APPAREL	PIJAMA	Pyjama	15	0	10			4	3	35	45	20	0	0	0	
24	APPAREL	POLO	Polo	45	0	10			4	5	20	35	45	0	0	0	
25	APPAREL	PULLOVER	Pullover	70	0	10			0.7	4	30	30	40	0	0	0	
26	APPAREL	RAINW	Raincoat	35	0	10	pair		0.6	2	35	35	30	1938	0	0	
27	APPAREL	SCARF	Scarf	35	0	7			2	3	25	40	35	0	0	0	
28	APPAREL	SKIRT	Skirt	20	0	10			11	5	35	35	30	0	0	0	
29	APPAREL	STOCKI	Stockings	5	0	5	pair		7	1	30	30	40	1952	0	0	
30	APPAREL	SWIMM	Swimsuit	15	0	10			1.4	2	35	35	30	1950	0	0	

Capitalism World is a mod that introduces a variety of new firms such as Airports, Amusement Parks, Doctors Offices and Movie Theatres in a very complicated economy of many different inputs:

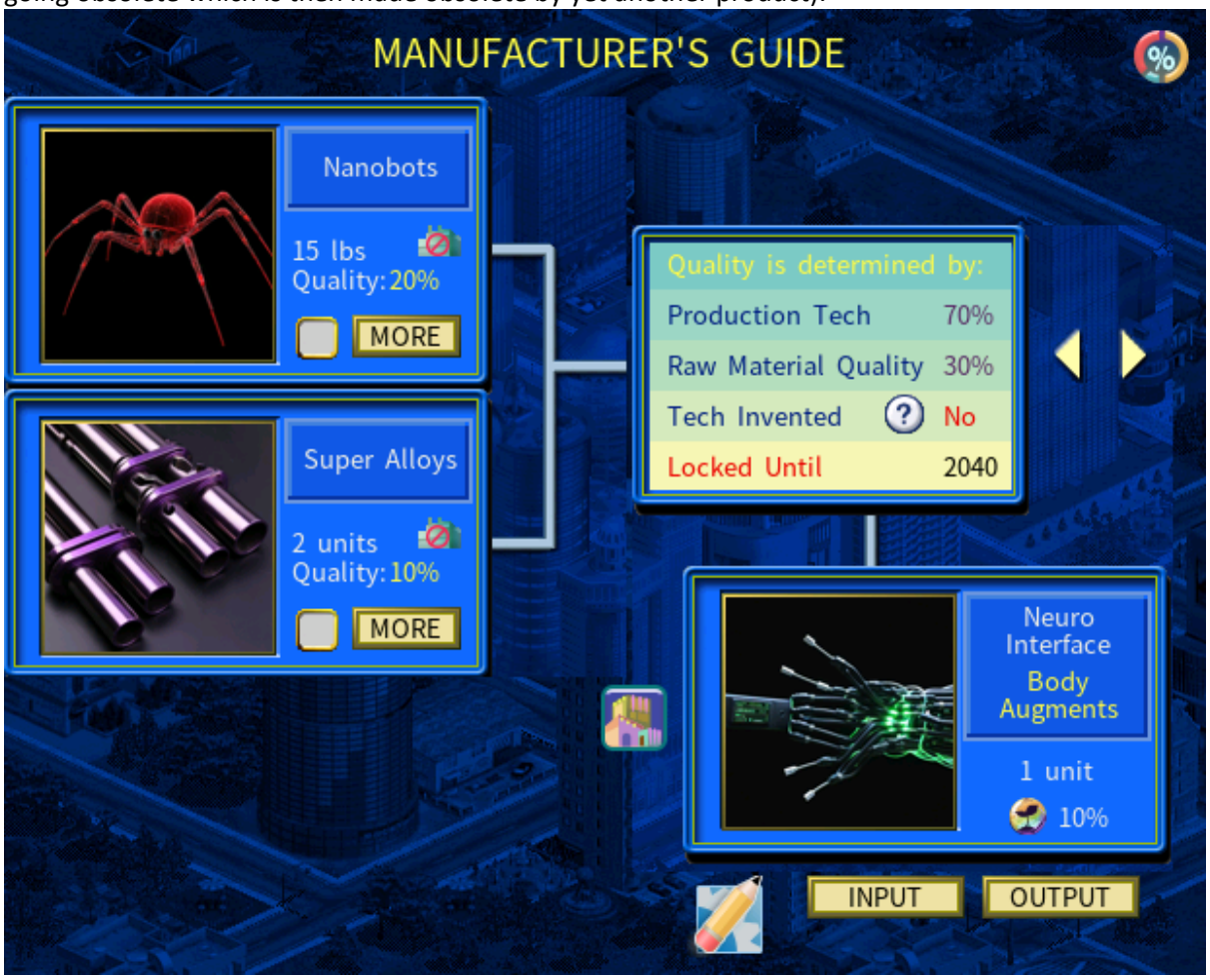
Select Building Type		
 Department Store	 Leather Store	 Shopping Mall
 Supermarket	 Computer Store	 Professional Stadium
 Convenience Store	 Cosmetic Store	 Pub
 Discount Megastore	 Furniture Store	 Home Improvement
 Drug Store	 Sports Store	 Investment Bank
 Apparel Store	 Toy Store	 Public Utilities
 Automobile Outlet	 Commercial Airport	 Farmers Market
 Electronics Store	 Gas Station	 Doctors Office
 Footwear Store	 Private Golf Course	 Amusement Park
 Jewelry and Watch Shop	 Private Hospital	 Movie Theater

All of these firms are considered to be retail stores and to simulate certain aspects of these stores such as skilled workers it utilises the farming system. For example a Doctor used for Medical Services is simulated as a ‘Crop’ that is ‘Sowed’ in August and ‘Harvested’ in June (which partially simulates semesters at colleges and universities) and the services themselves are produced in a factory and sold in a retail store (this mod does not use Service Firms).

While this system is not perfect (for example you can for example grow farm crops in a Private College and Doctors in a farm), it is still an interesting and creative way to simulate the inputs of firms which require educated professionals, something not normally available in the base game.

Check out this mod and see many of the other ways in which complex products and services are simulated.

FutureWorld is a speculative mod that attempts to simulate a world of futuristic products and gadgets. This is a mod that you should look at if you would to get ideas on how to create new and speculative products and technologies as well as how to setup obsolesce chains (i.e. one product going obsolete which is then made obsolete by yet another product).

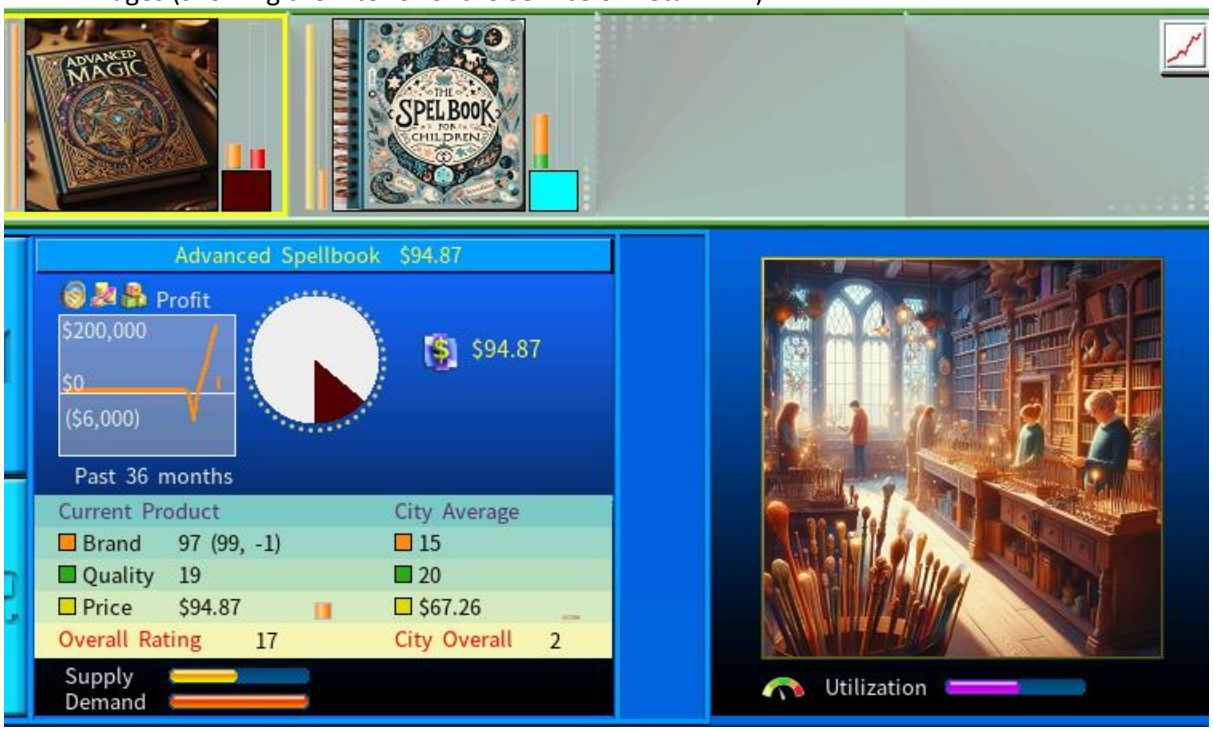


Magitek is a mod with a theme of fantasy magic combined with a modern industrial society that combines various magic based products with modern products (for example magic wands that use computer technology). This mod can give you many ideas if you are looking to create a fantasy/science fiction or other speculative mod.

This mod also introduces a number of changes that are not in most other mods but are fully supported by the Capitalism Lab game engine including:

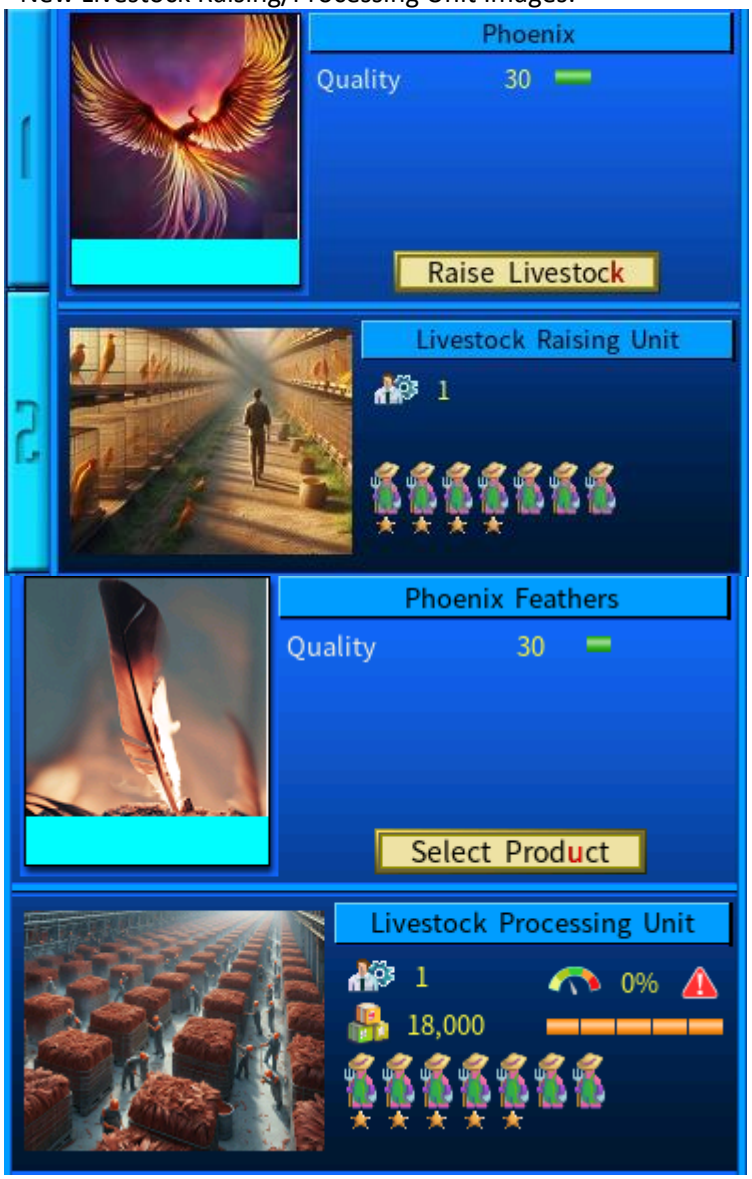
- Saved Layout Plan Libraries (using a PLO file):

- Firm Images (showing the interior of the Service or Retail firm):

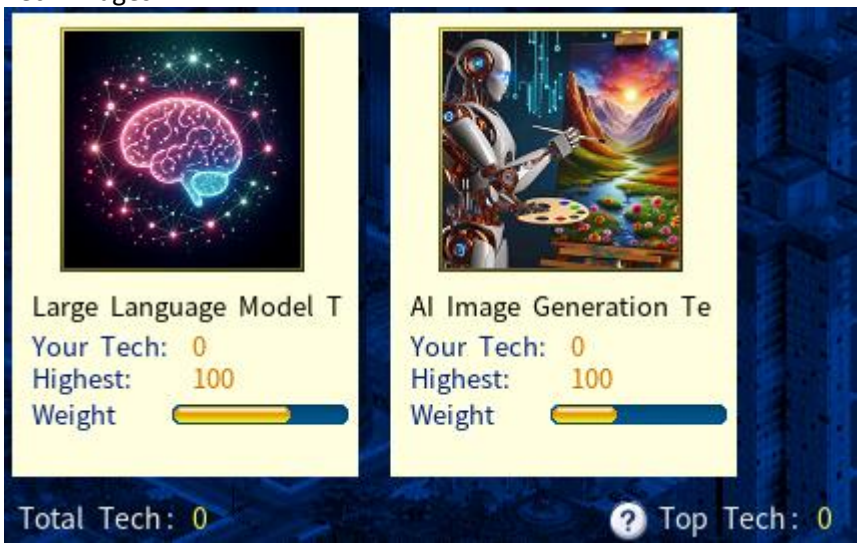


- New Service Prepare Unit Images:

- New Livestock Raising/Processing Unit Images:



Tech Images:



Check out the Magitek mod and Source to see how these changes were added and how they can potentially improve your mod.

Publishing

Once you are satisfied with your mod and are ready to release it to the public you can choose to publish it.

The method that you use to publish your mod is up to you, here is a basic checklist before you publish:

- You have completed testing of your mod and are satisfied that it is suitable for public release.
- You have put together all of the files of the mod into a single zip file. These files are:

MODNAME.RES (The core mod file, required)
MODNAME.txt (The text file for the mod, required)
MODNAME.png (The banner file used for the mod, optional but highly recommended)
MODNAME.PLO (The file used to add farm/factory/retail layouts, optional but highly recommended)
And other files that are part of your mod such as a description PDF (if you have written one).

- You can also add the Source of your mod (if you want), it should be in a separate file and have a different download link.

- You have access to a web host/file server for your mod; with a capacity of roughly 100MB (your mod may be larger or smaller, with the RES file using most of the space).

- You have written out a description of your mod. Your mod's description should have the following:

- A basic overview of your mod and its basic theme. Make sure it is exciting, interesting and catches the reader's attention.
- Specify what new features/products/firms/etc. it has.
- Have some screenshots of gameplay featuring some of the changes in your mod.
- Link to the mod

Check out the descriptions of other mods for some thoughts on what to write.

Once you have the files uploaded and the link ready create a thread in the Modding forum and paste in the description, screenshots and the download link.

You can also email Enlight and ask them nicely if they would also like to help publicise your mod as well (such as adding it to their social media posts, email newsletter, in game list of mods, etc.).

Updating your mod after publishing

After your mod is published you may want to make further changes to it. Some reasons why you might want to change your mod are:

- Fixing problems players found using your mod.
- Updating your mod to take advantage of new Capitalism Lab changes such as new DLCs or other changes.
- Adding new features such as more products, scenarios, new firms or anything else you want.

If you do change your mod:

- Update the version number to distinguish it from older versions (note that increasing the version number invalidates all previous save games using that mod, same issue if you add new products or firms).
- Take a copy or backup of the older mod version and save it somewhere else. You can provide the option for users to download the older versions.
- Add the new download link to the original mod post and add a changelog of what changes you made (and what version the changes were for).
- Make a post in the original thread so that everyone knows that the mod has been updated.