

# Vehicle Type Cargo Payment Modifiers – VTCPM

## 1. Introduction

Vehicle Type Cargo Payment Modifiers (or VTCPM in short) are a means of balancing the profitability of different vehicle types (trains, road vehicles, ships, aircraft) in OpenTTD, in an attempt to improve game-play by giving the player more (equally profitable) playing options. The principle of VTCPM is that, upon cargo delivery, the payment is multiplied by modifier (VTCPM modifier) *specific* to that vehicle type. Obviously, a VTCPM greater than 1 increases the payment (kind of “subsidizing” the route), while a VTCPM smaller than 1 decreases the payment.

## 2. Motivation

Historically, OpenTTD vehicle types are somewhat unbalanced: trains are much more profitable than road vehicles and ships (due to speed and capacity), while aircraft flying at their nominal speed (1/1) are profitable to the point of ruining the game. This is more obvious in competitive multiplayer games, where anything other than train routes is hardly ever built.

One solution, specific to aircraft, that has persisted for a long time in the game is the configurable in-game aircraft speed ( $1/1 - 1/4$ ), with the “quarter speed” setting being the default value. What this does is to reduce the speed of aircraft to a quarter of the nominal value, balancing aircraft profitability. The side effect of this is that some ground vehicles actually travel faster than aircraft in-game, a fact that tests the limits of “suspension of disbelief” for a percentage of the players, as evidenced in the “suggestions” and “problems” OpenTTD forums. This setting is of course configurable, so it is up to the player to decide on this. However, unless the default value of quarter speed is used, aircraft remain unbalanced, making it easy to make a lot of money in-game without too much effort.

Solutions to improve profitability of ships and road vehicles (as compared to that of trains) are constrained in the NewGRF domain. For example, the FISH ship set introduced vessels with large capacities (up to 1000+ units of cargo) to make up for their low speed. Unfortunately, game mechanics do not facilitate this solution: huge capacities really become useful when the production of an industry is also huge, which takes many game-years to happen. In other words, it is still much less profitable to use ships rather than trains in the beginning of a game.

Ideally, all four modes of transport should be balanced in such a way that terrain features, quantity

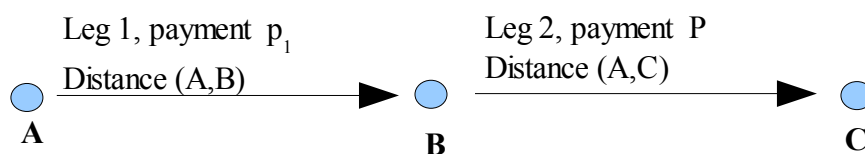
of water, distance between towns/industries and production dictate the appropriate choice. As it is now, trains are the best choice in the vast majority of cases (excluding aircraft, of course). Of course, one (separate) reason for this is the much more flexible implementation of trains: adjustable speed, running cost (engine), adjustable capacity (number of wagons) etc. Intelligent track layout/signaling also make it much more interesting (and rewarding) to play with trains. However, OpenTTD is a “transport simulation” and not “train simulation” game, thus all modes of transport should be viable choices (depending on the above mentioned factors).

### 3. Enter VTCPM

VTCP modifiers balance the vehicle types by adjusting the cargo payments depending on the vehicle type used. A separate VTCPM exists for aircraft, road vehicles and ships (trains being the reference). These can be found in Advanced Settings → Economy. A VTCPM is a percentage value of the original cargo payment. The default value of 100% is the normal game behaviour. A value less than 100% reduces the cargo payment (i.e. a setting of 50% will result in cargo payments equal to half the original), while a value larger than 100% increases the cargo payment (i.e. a setting of 200% will result in twice the original cargo payments). Aircraft get a VTCPM between 10-100%, while road vehicles and ships get a VTCPM that is always larger than 100% (up to 400%). Of course, testing is required to find optimal values for each vehicle type.

#### 3.1 Feeder Systems

OpenTTD implements a feeder (transfer) system that works as follows (see Illustration 1): A vehicle ( $V_1$ ) picks up cargo at point A and *transfers* it to point B.  $V_1$  gets paid payment  $p_1$ , equal to what the payment would have been if this was a normal delivery. Another vehicle ( $V_2$ ) picks up the same cargo and makes a final delivery at point C. The *route profit*  $P$  (that goes to the bank account) is the cargo payment for the *entire route*.  $V_2$  gets paid this amount *minus* the transfer payment of  $V_1$  (also termed the *feeder share*). This is done so that both vehicles share an amount of the route profit for their individual statistics.



*Illustration 1: Transportation from A to C using a transfer to B*

It is also possible to add more transfer legs (e.g.  $A \rightarrow B \rightarrow C \rightarrow D$ ) making long *feeder chains*. In this case, each vehicle making a transfer gets paid for its own leg (e.g.  $A \rightarrow B$ ,  $B \rightarrow C$ ), while the

feeder share is the *sum* of these transfer payments. Upon final delivery (e.g. point D) the route profit  $P$  of the whole journey ( $A \rightarrow D$ ) is paid in the bank account, while the last vehicle gets paid  $P$  minus the feeder share.

Implementing VTCPM into this system requires a bit of math. In Illustration 1, consider that the transfer payment of each vehicle in the feeder chain is modified by some percentage, depending on the vehicle type (aircraft, train, road vehicle, aircraft). If the transfer payments are modified, then the route profit also needs to be modified by a *route profit modifier*  $M$ .  $M$  is equal to the weighted average of the individual VTCP modifiers for each leg, with the transfer payments being the weights (see Equation 1).

$$M = \frac{m_1 \cdot p_1 + m_2 \cdot p_2}{p_1 + p_2} \quad (1)$$

where  $m_1, m_2$  are the VTCPM modifiers and  $p_1, p_2$  are the transfer profits for legs 1,2 respectively<sup>1</sup>

The denominator in the above equation is the feeder share (accumulated transfer payments of all legs), while the nominator is the sum of modified transfer payments, termed *modified feeder share*. The modified route profit is  $M \cdot P$ , while the final vehicle (making delivery) gets paid  $M \cdot P$  minus the modified feeder share. If all individual VTCP modifiers equal 100%, this yields the default behaviour ( $M = 1$ ). The extended formula for long feeder chains is shown below (Equation 2):

$$M = \frac{\sum_{i=1}^n m_i \cdot p_i}{\sum_{i=1}^n p_i} \quad (2)$$

Therefore, formula (2) yields the equivalent of the normal game behaviour (see Table 1):

Amount	Normal Game Behaviour	VTCPM
Transfer vehicle profit	$p_1$ ( <i>last station <math>\rightarrow</math> this station</i> )	$m_1 p_1$ ( <i>last station <math>\rightarrow</math> this station</i> )
Feeder share	$\Sigma p_i$	$\Sigma p_i$
Modified Feeder Share	-	$\Sigma m_i p_i$
Route profit	$P$ ( <i>origin <math>\rightarrow</math> this station</i> )	$M \cdot P$ ( <i>origin <math>\rightarrow</math> this station</i> )
Delivery vehicle profit	$P - (\text{feeder share})$	$M \cdot P - (\text{modified feeder share})$

Table 1: Comparison between normal and VTCPM game behaviour

Obviously, VTCPM modifiers equal to 1 (100%) always yield  $M = 1$  and (modified feeder share = feeder share), reverting to the original game behaviour.

<sup>1</sup> Note that in this case we do calculate the “transfer” profit of the last vehicle in order to use it as a weight for the calculation of  $M$

## **4. Implementation**

VTCPM is implemented as an independently supported OpenTTD patch. You can find the patch file in the VTCPM thread in the “OpenTTD development” forum. You need to be able to compile OpenTTD yourself in order to use this patch. Complete (patched) OpenTTD bundles may be published from time to time. The patch is published under the same license as OpenTTD (GPL) and same rules apply.

If you have any questions, suggestions, problems, bug reports etc, please post all of these in the VTCPM thread in the “OpenTTD development” forum. Please do NOT post bug reports and other problems in other threads: this patch is not supported by the OpenTTD developers; as already mentioned, it is supported independently (by me).

## **5. Future work**

A number of possible future game features can be envisaged on the basis of this patch:

- Model-specific VTCPM exposed to NewGRF spec: NewGRF authors may be able to specify a modifier for each vehicle in their set, as a way to manage overpowered vehicles
- Random VTCPM: Randomize VTCP modifiers for each vehicle type at the start of the game (within reasonable limits) in order to provide variety. This works similarly to random vehicle reliability.
- Award VTCPM: In-game awards increase modifiers for certain achievements (e.g. Road Master: unlocked when player owns >120 profitable road vehicles. Road vehicle VTCPM +10 %)

However, this does NOT mean that all of these (and maybe others) will be included in the VTCPM patch. Most probably they would be included in separate patches.

## **6. Miscellaneous**

The author of these notes, as well as the VTCPM patch is Tafidis (OpenTTD forums account name). Once again, please post inquiries ONLY in the VTCPM thread.