Semester Championship Documentation

Vehicle Mechanics Fundamentals

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1 General

1.1. My goal

First, let me explain the strategy chosen. I have decided that I don't want to tune the car for a specific type of track and win those races, but I want to achieve an average best setting for all tracks. Thus, when optimizing the car, I always aimed to minimize the total lap time for all tracks.

1.2. Tools

I have recorded the actual parameters and costs in tabular form to keep track of the results. Including simulated lap times, improvement rates, total lap times, total improvement, and deviation of improvements for each track. The table contains brief information on changes, conclusions, and decisions for the current setting. In the first phase of setting up the car, I used only this to narrow down the range of settings to those that were probably optimal.

1.3. Development stages

In the first phase, I wanted to find an initial setup where all costs are used for one component. From this setting, I can think backwards to develop the setting further. In the next phase, I have logically combined the parameters in proportion to the improvements in the initial settings, further narrowing the range of possible good settings. Once I had narrowed down the possible settings and got an idea of the impact of the parameters, in the third phase I used the corresponding Optimum Lap diagrams to investigate the effects of the changes, make decisions and find the best setting.

1.4. Development cost table

De	velopment cost table	S	tep	Cost	Default		
		step unit	dimension	\$/step	value		
Tire Data							
	Longitudinal Friction	0.005	-	10.00 M	2.100		
	Lateral Friction	0.005	-	20.00 M	1.950		
Aero Data							
	Aero Efficiency	0.010	-	5.00 M	2.000		
Scaling facto	ors						
	Power factor	0.100	%	1.18 M	100.000		
General							
	Weight	0.500	kg	1.20 M	743.000		
The	e available budget for the te	eam is		100.00 M			

2. First development stage

										_							
0	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de	Red Bull	Suzuka	
0.0000	Lateral Friction Aero Efficiency	0	1.950 2.000	0.00 M 0.00 M	International Circuit	International Circuit	Catalunya	Monaco	Nevers	Villeneuve	Circuit	Nürburgring	Hungaroring	Spa- Francorcham	Ring	International	
Σ update	Power factor	0	100.000	0.00 M					Magny-Cours							Racing	
-	Weight	0	743.000	0.00 M	87.48 s	91.39 s	76.59 s	71.37 s	68.18 s	69.39 s	83.59 s	81.02 s	72.85 s	101.38 s	64.16 s	86.09 s	laptime
0.00 s			sum	0.00 M	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	update
Σ laptime			remaining	100.00 M					0.00	0.00							upuute
953.49 s	This is the base car.	All of the budget is remaining to be spent. Spending the whole budget on one factor, and then working backwards there. Have to find which aspect to max out.								kwards from	comment						
										_		to find which	aspect to ma	x out.			
1	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone	**************************************		Circuit de	Red Bull	Suzuka	
0.4167	Lateral Friction Aero Efficiency	0	1.950 2.000	0.00 M 0.00 M	International Circuit	International Circuit	Catalunya	Monaco	Nevers Magny-Cours	Villeneuve	Circuit	Nürburgring	nungaroring	Spa- Francorcham	Ring	International Racing	
Σ update	Power factor	84	108.400	99.12 M												_	
-11.10 s	Weight	0	743.000	0.00 M	86.48 s	90.46 s	75.87 s	71.38 s	67.21 s	68.55 s	82.22 s	80.09 s	72.25 s	99.68 s	63.30 s	84.90 s	laptime
-11.10 S			sum	99.12 M	-1.00 s	-0.93 s	-0.72 s	0.01 s	-0.97 s	-0.84 s	-1.37 s	-0.93 s	-0.60 s	-1.70 s	-0.86 s	-1.19 s	update
Σ laptime	Ii	- 4- 41	remaining	0.88 M	Df b						F 4b:	- : :-	-:-:				
942.39 s	Increasing the engine power	r to the ma	ximum to get in	iitiai setup.	Performs bett	er on almost	every track.				For now, thi	s is the best if	nitiai setup t	o work backwa	ras irom.		comment
2	Development	Step	Value	Cost						Tra	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de	Red Bull	Suzuka	
0.2353	Lateral Friction	0	1.950	0.00 M		International	Catalunya	Monaco	Nevers	Villeneuve	Circuit	Nürburgring	Hungaroring	Spa-	Ring	International	
F	Aero Efficiency	0	2.000	0.00 M	Circuit	Circuit	•		Magny-Cours					Francorcham		Racing	
Σ update	Power factor Weight	0 83	100.000 701.500	0.00 M 99.60 M	86.53 s	90.33 s	75.71 s	71.07 s	67.55 s	68.72 s	82.74 s	79.99 s	71.84 s	100.42 s	63.32 s	84.92 s	laptime
-10.35 s	Weight		sum	99.60 M	-0.95 s	-1.06 s	-0.88 s	-0.30 s	-0.63 s	-0.67 s	-0.85 s	-1.03 s	-1.01 s	-0.96 s	-0.84 s	-1.17 s	update
Σ laptime	D : :		remaining	0.40 M					0.000	5.57.5				0.505	0.012	2.27 5	apaute
943.14 s	Decreasing the weight to the	e minimum	i to get initial se	etup.	Maximizing e	ngine power	performs bet	ter overall.			Not changin	g the initial se	etup to this.				comment
3	Development	Step	Value	Cost						Tra	ack						
3 deviation	Development Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de					Circuit de	Red Bull	Suzuka	
deviation 0.4165	Longitudinal Friction Lateral Friction	0	2.100 1.950	0.00 M 0.00 M	International	International	Circuit de Catalunya	Circuit de Monaco	Nevers	Tr. Circuit Gilles Villeneuve	ack Silverstone Circuit	Nürburgring	Hungaroring	Spa-	Red Bull Ring	International	
0.4165	Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20	2.100 1.950 2.200	0.00 M 0.00 M 100.00 M		_				Circuit Gilles	Silverstone	Nürburgring	Hungaroring				
0.4165 Σ update	Longitudinal Friction Lateral Friction Aero Efficiency Power factor	0	2.100 1.950	0.00 M 0.00 M	International	International			Nevers	Circuit Gilles	Silverstone	Nürburgring 80.13 s	Hungaroring 72.21 s	Spa-		International	laptime
0.4165	Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0	2.100 1.950 2.200 100.000	0.00 M 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s	International Circuit 90.44 s	Catalunya 75.79 s	Monaco 71.35 s	Nevers Magny-Cours 67.23 s	Circuit Gilles Villeneuve 68.60 s	Silverstone Circuit 82.17 s	80.13 s	72.21 s	Spa- Francorcham 99.65 s	Ring 63.38 s	International Racing 84.93 s	
0.4165 Σ update	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight	0 0 20 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s -0.97 s	International Circuit 90.44 s -0.95 s	75.79 s -0.80 s	71.35 s -0.02 s	Nevers Magny-Cours 67.23 s -0.95 s	Circuit Gilles Villeneuve 68.60 s -0.79 s	Silverstone Circuit 82.17 s -1.42 s	80.13 s -0.89 s	72.21 s -0.64 s	Spa- Francorcham 99.65 s -1.73 s	Ring 63.38 s -0.78 s	International Racing 84.93 s -1.16 s	laptime update
0.4165 Σ update -11.10 s	Longitudinal Friction Lateral Friction Aero Efficiency Power factor	0 0 20 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it per	International Circuit 90.44 s -0.95 s forms the sar	75.79 s -0.80 s me as maxim	Monaco 71.35 s -0.02 s izing the eng	Nevers Magny-Cours 67.23 s	Circuit Gilles Villeneuve 68.60 s -0.79 s	Silverstone Circuit 82.17 s -1.42 s Even though	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n	Spa- Francorcham 99.65 s -1.73 s ot changing the	Ring 63.38 s -0.78 s e initial set	International Racing 84.93 s -1.16 s	
0.4165 $\Sigma \text{ update} \\ -11.10 \text{ s} \\ \Sigma \text{ laptime}$	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience	0 0 20 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup.	International Circuit 86.51 s -0.97 s	International Circuit 90.44 s -0.95 s forms the sar	75.79 s -0.80 s me as maxim	Monaco 71.35 s -0.02 s izing the eng	Nevers Magny-Cours 67.23 s -0.95 s	Circuit Gilles Villeneuve 68.60 s -0.79 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n	Spa- Francorcham 99.65 s -1.73 s	Ring 63.38 s -0.78 s e initial set	International Racing 84.93 s -1.16 s	update
0.4165 $\Sigma \text{ update} \\ -11.10 \text{ s} \\ \Sigma \text{ laptime}$	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight	0 0 20 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it per	International Circuit 90.44 s -0.95 s forms the sar	75.79 s -0.80 s me as maxim er track is sm	Monaco 71.35 s -0.02 s izing the engaller.	Nevers Magny-Cours 67.23 s -0.95 s	Circuit Gilles Villeneuve 68.60 s -0.79 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n	Spa- Francorcham 99.65 s -1.73 s ot changing the	Ring 63.38 s -0.78 s e initial set o.	International Racing 84.93 s -1.16 s	update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development	0 0 20 0 0 0 cy to the ma	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup.	International Circuit 86.51 s -0.97 s Overall it periodevation of the	International Circuit 90.44 s -0.95 s forms the same updates p	75.79 s -0.80 s me as maxim er track is sm	Monaco 71.35 s -0.02 s izing the engaller. Circuit de	Nevers Magny-Cours 67.23 s -0.95 s zine power, bu	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g	Ring 63.38 s -0.78 s e initial set o. Red Bull	International Racing 84.93 s -1.16 s up to this, as	update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 Step 0 5	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the	International Circuit 90.44 s -0.95 s forms the sai	75.79 s -0.80 s me as maxim er track is sm	Monaco 71.35 s -0.02 s izing the engaller.	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de	Circuit Gilles Villeneuve 68.60 s -0.79 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n derstandable	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g	Ring 63.38 s -0.78 s e initial set o.	International Racing 84.93 s -1.16 s up to this, as	update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor	0 0 20 0 0 0 Step 0 5 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International	75.79 s -0.80 s me as maxim er track is sm	Monaco 71.35 s -0.02 s izing the engaller. Circuit de	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone	80.13 s -0.89 s the deviation	72.21 s -0.64 s is smaller n derstandable	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa-	Ring 63.38 s -0.78 s e initial set o. Red Bull	International Racing 84.93 s -1.16 s up to this, as Suzuka International	update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 Step 0 5	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s	80.13 s -0.89 s In the deviation or is more und Nürburgring 80.54 s	72.21 s -0.64 s is smaller in derstandable Hungaroring 72.36 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s	update comment
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor	0 0 20 0 0 0 Step 0 5 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit	80.13 s -0.89 s I the deviation or is more unc	72.21 s -0.64 s is smaller n derstandable	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing	update comment
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor	0 0 20 0 0 cy to the m: Step 0 5 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s	Silverstone Circuit 82.17 s -1.42 s Even though engine powack Silverstone Circuit 83.21 s -0.38 s	80.13 s -0.89 s In the deviation or is more und Nürburgring 80.54 s	72.21 s -0.64 s is smaller n derstandable Hungaroring 72.36 s -0.49 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s	update comment
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight	0 0 20 0 0 cy to the m: Step 0 5 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s	Silverstone Circuit 82.17 s -1.42 s Even though engine powack Silverstone Circuit 83.21 s -0.38 s	80.13 s -0.89 s I the deviation or is more und Nürburgring 80.54 s -0.48 s	72.21 s -0.64 s is smaller n derstandable Hungaroring 72.36 s -0.49 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s	update comment laptime update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction	0 0 20 0 0 cy to the mass Step 0 5 0 0 0 0 o o o o o o o o o o o o o o	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s s.	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s -0.38 s Not changin	80.13 s -0.89 s I the deviation or is more und Nürburgring 80.54 s -0.48 s	72.21 s -0.64 s is smaller n derstandable Hungaroring 72.36 s -0.49 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s	Ring 63.38 s -0.78 s e initial set 0. Red Bull Ring 63.82 s -0.34 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s	update comment laptime update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development	0 0 20 0 0 0 cy to the max Step 0 5 0 0 0 0 cy to the max Step 5 0 0 0 0 0 cy to the max Step 5 0 0 0 0 0 0 cy to the max Step 5 0 0 0 0 0 cy to the max Step 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in	0.00 M 0.00 M 100.00 M 0.00 M 100.00 M 100.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s S.	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s	Silverstone Circuit 82.17 s -1.42 s Even though engine powack Silverstone Circuit 83.21 s -0.38 s Not changinack	80.13 s -0.89 s I the deviation or is more und Nürburgring 80.54 s -0.48 s	72.21 s -0.64 s is smaller in derstandable Hungaroring 72.36 s -0.49 s etup to this.	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s -0.34 s	International Racing 84.93 s -1.16 s tup to this, as Suzuka International Racing 85.58 s -0.51 s	update comment laptime update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation 0.0779	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development Longitudinal Friction Lateral Friction Aero Efficiency Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 Cy to the missing Step 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in Value 2.150 1.950 2.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s s.	Nevers Magny-Cours 67.23 s -0.95 s tine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s -0.38 s Not changin	80.13 s -0.89 s In the deviation or is more und Nürburgring 80.54 s -0.48 s g the initial se	72.21 s -0.64 s is smaller in derstandable Hungaroring 72.36 s -0.49 s etup to this.	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s	Ring 63.38 s -0.78 s e initial set 0. Red Bull Ring 63.82 s -0.34 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s -0.51 s	update comment laptime update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 cy to the max Step 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in Value 2.150 1.950 2.000 100.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors Sepang International	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a Shanghai International	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s S.	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s Circuit de Nevers	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s	Silverstone Circuit 82.17 s -1.42 s Even though engine powack Silverstone Circuit 83.21 s -0.38 s Not changinack	80.13 s -0.89 s In the deviation or is more und Nürburgring 80.54 s -0.48 s g the initial se	72.21 s -0.64 s is smaller in derstandable Hungaroring 72.36 s -0.49 s etup to this.	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s Circuit de Spa-	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s -0.34 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s -0.51 s	update comment laptime update
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation 0.0779	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development Longitudinal Friction Lateral Friction Aero Efficiency Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 Cy to the missing Step 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in Value 2.150 1.950 2.000 100.000 743.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors Sepang International Circuit 87.23 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a Shanghai International Circuit 91.12 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor Circuit de Catalunya 76.34 s	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s s. Circuit de Monaco 71.40 s	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s Circuit de Nevers Magny-Cours 67.98 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s Tr. Circuit Gilles Villeneuve 69.19 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s -0.38 s Not changin ack Silverstone Circuit 83.43 s	80.13 s -0.89 s In the deviation or is more unconstruction of the deviation of the deviatio	72.21 s -0.64 s is smaller in derstandable Hungaroring 72.36 s -0.49 s etup to this. Hungaroring 72.63 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s Circuit de Spa- Francorcham 101.19 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s -0.34 s Red Bull Ring 64.02 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s -0.51 s Suzuka International Racing 85.92 s	update comment laptime update comment
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation 0.0779 Σ update	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 cy to the max Step 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in Value 2.150 1.950 2.000 100.000	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 0.00 M nitial setup. Cost 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors Sepang International Circuit	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a Shanghai International Circuit	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s above 3 factor Circuit de Catalunya	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s s. Circuit de Monaco	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s Circuit de Nevers Magny-Cours	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s Tr. Circuit Gilles Villeneuve	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s -0.38 s Not changinack Silverstone Circuit	80.13 s -0.89 s I the deviation or is more und Nürburgring 80.54 s -0.48 s g the initial so	72.21 s -0.64 s It is smaller n Iderstandable Hungaroring 72.36 s -0.49 s etup to this. Hungaroring	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s Circuit de Spa- Francorcham	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s -0.34 s	International Racing 84.93 s -1.16 s sup to this, as Suzuka International Racing 85.58 s -0.51 s Suzuka International Racing	update comment laptime update comment
0.4165 Σ update -11.10 s Σ laptime 942.39 s 4 deviation 0.1355 Σ update -4.59 s Σ laptime 948.90 s 5 deviation 0.0779 Σ update -2.22 s	Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the aero efficience Development Longitudinal Friction Lateral Friction Aero Efficiency Power factor Weight Increasing the lateral friction Development Longitudinal Friction Lateral Friction Aero Efficiency	0 0 20 0 0 0 cy to the max Step 0 5 0 0 0 0 cy to the max Step 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.100 1.950 2.200 100.000 743.000 sum remaining aximum to get in Value 2.100 1.975 2.000 100.000 743.000 sum remaining aximum to get in Value 2.150 1.950 2.000 100.000 743.000 sum remaining	0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 100.00 M 100.00 M nitial setup. Cost 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 100.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M 0.00 M	International Circuit 86.51 s -0.97 s Overall it periodevation of the Sepang International Circuit 87.13 s -0.35 s Performs wors Sepang International Circuit 87.23 s	International Circuit 90.44 s -0.95 s forms the same updates p Shanghai International Circuit 90.85 s -0.54 s se than the a Shanghai International Circuit 91.12 s -0.27 s	75.79 s -0.80 s me as maxim er track is sm Circuit de Catalunya 76.14 s -0.45 s bove 3 factor Circuit de Catalunya 76.34 s	Monaco 71.35 s -0.02 s izing the engaller. Circuit de Monaco 71.32 s -0.05 s s. Circuit de Monaco 71.40 s	Nevers Magny-Cours 67.23 s -0.95 s gine power, bu Circuit de Nevers Magny-Cours 67.91 s -0.27 s Circuit de Nevers Magny-Cours 67.98 s	Circuit Gilles Villeneuve 68.60 s -0.79 s It the Tr. Circuit Gilles Villeneuve 69.09 s -0.30 s Tr. Circuit Gilles Villeneuve 69.19 s	Silverstone Circuit 82.17 s -1.42 s Even though engine pow ack Silverstone Circuit 83.21 s -0.38 s Not changin ack Silverstone Circuit 83.43 s -0.16 s	80.13 s -0.89 s In the deviation or is more unconstruction of the deviation of the deviatio	72.21 s -0.64 s It is smaller in derstandable Hungaroring 72.36 s -0.49 s etup to this. Hungaroring 72.63 s -0.22 s	Spa- Francorcham 99.65 s -1.73 s ot changing the from the get g Circuit de Spa- Francorcham 100.95 s -0.43 s Circuit de Spa- Francorcham 101.19 s	Ring 63.38 s -0.78 s e initial set o. Red Bull Ring 63.82 s -0.34 s Red Bull Ring 64.02 s	International Racing 84.93 s -1.16 s up to this, as Suzuka International Racing 85.58 s -0.51 s Suzuka International Racing 85.92 s	update comment laptime update comment

3. Second development stage

0	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de Spa-		Suzuka	
0.0000	Lateral Friction Aero Efficiency	0	1.950 2.000	0.00 M 0.00 M	International Circuit	International Circuit	Catalunya	Monaco	Nevers Magny-Cours	Villeneuve	Circuit	Nürburgring	Hungaroring	Francorcham ps	Red Bull Ring	International Racing Course	
Σ update	Power factor Weight	0	100.000 743.000	0.00 M 0.00 M	87.48 s	91.39 s	76.59 s	71.37 s	68.18 s	69.39 s	83.59 s	81.02 s	72.85 s	101.38 s	64.16 s	86.09 s	laptime
0.00 s Σ laptime	Troight.	Ĭ	sum remaining	0.00 M 100.00 M	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	update
	This is the base car.		remaining	100.00 IVI	All of the budge	t is remaining to	o be spent.				Spending the v	vhole budget on	one factor, an	d then working b	ackwards fron	n there. Have	
953.49 s	to find which aspect to max out.												comment				
1	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de Spa-		Suzuka	
0.4167	Lateral Friction	0	1.950	0.00 M		International	Catalunya	Monaco	Nevers	Villeneuve	Circuit	Nürburgring	Hungaroring	Francorcham	Red Bull Ring		
	Aero Efficiency	0	2.000	0.00 M	Circuit	Circuit	catalanya	Williago	Magny-Cours	VIIICIICUVC	Circuit			ps		Racing Course	
Σupdate	Power factor	84	108.400	99.12 M	86.48 s	90.46 s	75.87 s	71.38 s	67.21 s	68.55 s	82.22 s	80.09 s	72.25 s	99.68 s	63.30 s	84.90 s	laptime
-11.10 s	Weight	0	743.000 sum	0.00 M 99.12 M													
Σlaptime			remaining	0.88 M	-1.00 s	-0.93 s	-0.72 s	0.01 s	-0.97 s	-0.84 s	-1.37 s	-0.93 s	-0.60 s	-1.70 s	-0.86 s	-1.19 s	update
942.39 s	Increasing the engine power to the	he maximum		о.	Performs bette	on almost ever	ry track.				This will be the	initial setup.					comment
2	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai			Circuit de					Circuit de Spa-		Suzuka	
0.0259	Lateral Friction	0	1.950	0.00 M		International	Circuit de	Circuit de	Nevers	Circuit Gilles Villeneuve	Silverstone Circuit	Nürburgring	Hungaroring	Francorcham	Red Bull Ring	International	
0.0259	Aero Efficiency	10	2.100	50.00 M	Circuit	Circuit	Catalunya	Monaco	Magny-Cours	villeneuve	Circuit			ps		Racing Course	
Σupdate	Power factor	42	104.200	49.56 M	86.47 s	90.42 s	75.80 s	71.35 s	67.19 s	68.55 s	82.16 s	80.08 s	72.20 s	99.62 s	63.31 s	84.88 s	laptime
-0.36 s	Weight	0	743.000	0.00 M	555	3023	70.003	72.003	07.123.3	00.000	02.103	50.003	, 2,203	33.023	00.023	0.1.003	шрине
-1			sum	99.56 M	-0.01 s	-0.04 s	-0.07 s	-0.03 s	-0.02 s	0.00 s	-0.06 s	-0.01 s	-0.05 s	-0.06 s	0.01 s	-0.02 s	update
Σlaptime	When choosing the initial setup, t	the Aero Effi	remaining	0.44 M	, Dorforms slightl	v hottor almost	on overv track				This is a hottor	result, keeping	this iteration				
942.03 s	similar performance increase. Spe		•			y better annost	on every track	•			Tills is a petter	result, keeping	this iteration.				comment
3	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	0	2.100	0.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de Spa-		Suzuka	
0.1026	Lateral Friction	0	1.950	0.00 M	International	International	Catalunya	Monaco	Nevers	Villeneuve	Circuit	Nürburgring	Hungaroring	Francorcham	Red Bull Ring	International	
	Aero Efficiency	7	2.070	35.00 M	Circuit	Circuit	catalanya	***************************************	Magny-Cours	***************************************	Circuit			ps		Racing Course	
Σupdate	Power factor	28 26	102.800	33.04 M	86.46 s	90.38 s	75.73 s	71.26 s	67.30 s	68.60 s	82.32 s	80.05 s	72.09 s	99.85 s	63.31 s	84.89 s	laptime
0.21 s	Weight	20	730.000 sum	31.20 M 99.24 M													
Σlaptime			remaining	0.76 M	-0.02 s	-0.08 s	-0.14 s	-0.12 s	0.09 s	0.05 s	0.10 s	-0.04 s	-0.16 s	0.17 s	0.01 s	-0.01 s	update
942.24 s	Combining the three top perform performance increase.	based on their	Performs worse	overall.					Not keeping this iteration.						comment		
4	Development	Step	Value	Cost						Tr	ack						
deviation	Longitudinal Friction	1	2.105	10.00 M	Sepang	Shanghai	Circuit de	Circuit de	Circuit de	Circuit Gilles	Silverstone			Circuit de Spa-		Suzuka	
0.1868	Lateral Friction	1	1.955	20.00 M		International	Catalunya	Monaco	Nevers	Villeneuve	Circuit	Nürburgring	Hungaroring	Francorcham	Red Bull Ring	International	
	Aero Efficiency	4	2.040	20.00 M	Circuit	Circuit	Jana Janya		Magny-Cours					ps		Racing Course	
Σupdate	Power factor	20	102.000	23.60 M	86.66 s	90.55 s	75.87 s	71.29 s	67.50 s	68.76 s	82.64 s	80.23 s	72.19 s	100.23 s	63.49 s	85.14 s	laptime
2.31 s	Weight	22	732.000	26.40 M													
Σlaptime			sum remaining	100.00 M 0.00 M	0.18 s	0.09 s	0.00 s	-0.09 s	0.29 s	0.21 s	0.42 s	0.14 s	-0.06 s	0.55 s	0.19 s	0.24 s	update
944.55 s	Combining all of the parameters of performance increase.	of the initial			Performs even v	worse then the p	previous iterati	on.			Changing the f	riction coefficie	nts might not b	e a viable option	. Very high cos	t, very low	comment
	periormance morease.										pucc.						

4. Third development stage