

Manual AssetPlanner Light

Long Term Asset Planner

Strategic model (v0.57) – demo version

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1 Introduction

This document contains the Operating Instructions for the strategic AssetPlanner (abstract model; hereafter referred to as "the Model"). This document describes the following aspects:

1. Purpose and limitations
2. Construction of the model
3. Working with the model
4. Detailed backgrounds of the model

2 Purpose and limitations

The model is intended for a group of similar objects (the so-called asset type) to provide a long-term forecast for the conservation of the group. This forecast concerns three partial questions:

1. What happens to these objects if we leave them to their destiny?
2. What is the optimal replacement strategy for the group?
3. What is the consequence of adjusting this optimal strategy to the preconditions set by the organization?

The answers to these questions are formulated in terms of number of interventions and the associated effects on business values, both per annum and added to a net present value (NPV). Because forecasts are by definition uncertain, the model focuses on 'what if' analysis rather than on the exact answer. This makes it possible to explicitly test whether the chosen strategy is robust under uncertainty, instead of hiding this uncertainty.

The model (light!) is limited in the number of interventions that can be considered. These are:

- [1] Corrective replacement after failure due to aging
- [2] Repairs after failure due to aging
- [3] Preventive replacement
- [4] Functional replacement
- [5] Repair after external disruption
- [6] Routine maintenance and operation

These interventions are linked one to one to a failure mechanism. Interventions 1-4 coincide with the failure risk development due to wear and aging. Intervention 5 is age-independent. Intervention 6 concerns a fixed amount per year.

Partial question 1 concerns the forecast if no preventive replacements are conducted. For the purpose of answering partial question 2, an optimal replacement age must be calculated. This is the time when the risk of postponing the replacement with 1 year becomes as expensive as the benefit of delaying. The prognosis then replaces the object at this age with a new one with the same characteristics. In some cases (e.g. optimal year less than highest age in group, erratic pattern in construction), implementing this optimal strategy can lead to major peaks in execution (financially and in time) that are practically unrealizable. Adapting the strategy to the organization's preconditions is the subject of the third partial question. The model uses one boundary condition, the budget. Additionally, the replacement moment can also be shifted.

For many objects there is a technical development, which means that new units in the group perform better in terms of maintenance needs and other operational costs. This has been included in the model by distinction in two generations (mark 1 and mark 2) with a moment from when the second generation is deployed.

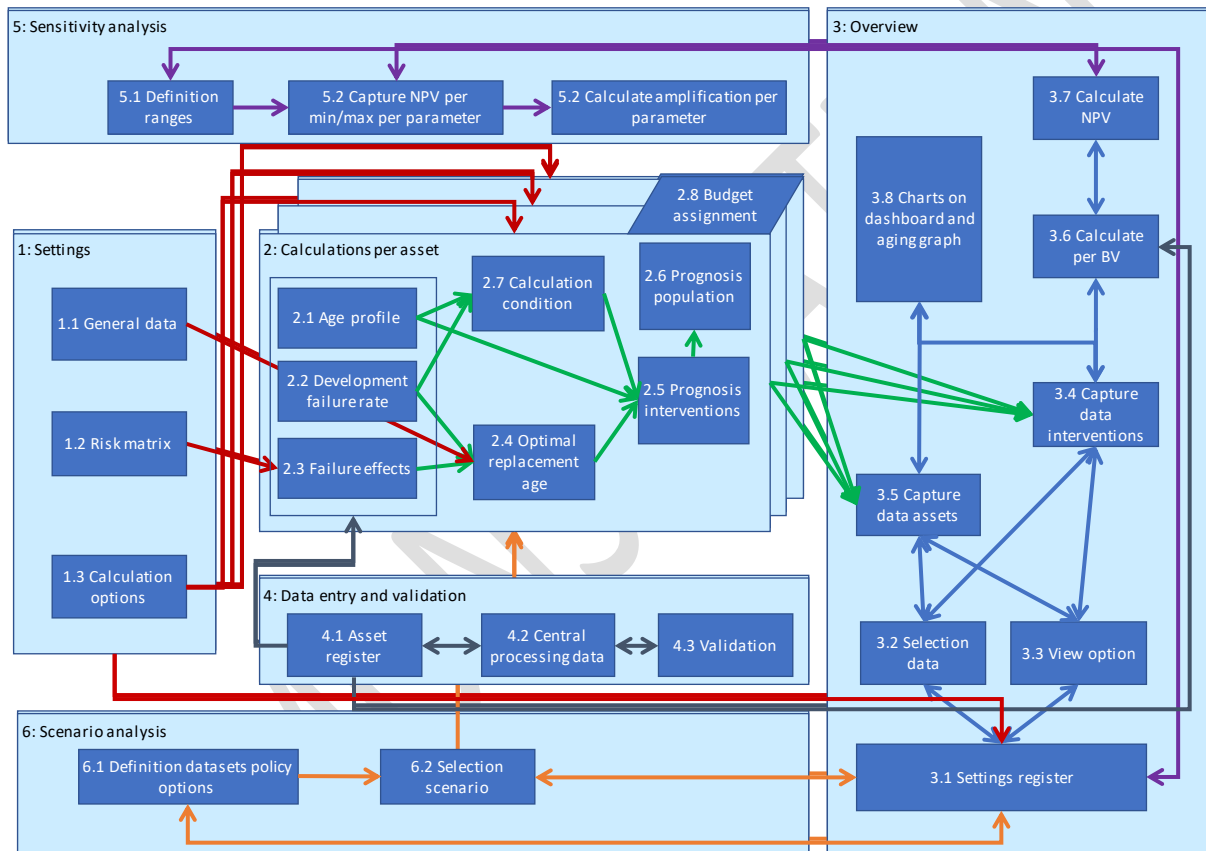
The model does not take into account:

- The relationship between maintenance and end of life: End of service life is expected to be caused by a non-maintenance component, the necessary maintenance for achieving that end of life is deemed to be performed (part of discrete AssetPlanner; tactical version)
- Failure of other assets that induce or exacerbate failure of the modeled objects (network model).

3 Construction of the model

The model consists of a number of modules, each of which executes part of the functionality. Generally the modules are (for the sake of clarity) implemented on one (or more) separate tab(s).

Due to the large number of modules, they are graphically displayed, followed by a brief description of the functionality and the tabs used per module.



The following table describes briefly what the functionality is, which tabs are used for that purpose and whether user input is required.

NR	Module	Functionality	Tabs
1	Settings	Determine the structure of the.	Dashboard (data entry), BVModel (data entry)
2	Calculations per asset	Based on specified parameters, the interventions are forecasted and translated into effects on business values. Enter data for the asset type on the tab "AssetSheet". Budget assignment takes place across all assets.	AssetValidation, AgeProfile. Charts
3	Overview	Select and collect the number of interventions and effects on the business values. The display options are set to the dashboard.	Dashboard, Charts, AgeProfiles

NR	Module	Functionality	Tabs
4	Data entry and validation	Enter data by asset type and validation using historical failure data.	AssetSheet, AgeProfile, AssetValidation, AssetRegister
5	Sensitivity analysis	Determine the sensitivity of data. A range of 10 items can be specified.	Dashboard, Sensitivity (calculation)
6	Scenario analysis	Ability to define combinations of variables. The variables are the same as for the sensitivity analysis. Per scenario, sensitivity can also be determined	Dashboard (data entry), Settings

This manual focuses on the tabs on which import and export occur. The underlying principles are discussed in Chapter 5. In the model itself a tab has been included (Index) where the references, list lists and colors are specified.

4 Working with the model

User interaction is limited to four tabs: BVModel, AssetSheet, AgeProfile and Dashboard. For the first 3 tabs, the interaction is in principle once: for the introduction of the business value model (BVModel) and asset base data (AssetSheet and AgeProfile).

The main entry is via the Dashboard and Presentation. Here, the general data (except for the risk matrix) can be specified and all display options and strategic choices are determined. All other tabs contain validation options or calculations, which are briefly discussed in chapter 5. In the model, all cells where users can enter data are white, the remaining cells contain formulas and are normally blocked. Changing these cells can lead to irreparable damage to the model.

4.1 Business value model

The BVModel tab contains the organization's business value model. The desired entry is limited to naming the non-financial business values, the KPI per business value and the monetary equivalent of that KPI. The model contains the following: all qualitative business values are valued by points with a point corresponding to a euro. The number of points for an effect is then the geometric mean of the corresponding financial cell. Below is the basic entry displayed (white cells).

In general clicking on the cell at the top left, the application will jump to the Presentation tab.

Aspect	M.E.	KPI
1 OPEX	1 €	
1 Investment	1 €	
1 Emergency measures	1 €	
1 Repair cost	1 €	
1 Additional cost	1 €	
2 Customer days scheduled	1 €q	
2 Customer days unscheduled	1 €q	
3 Quantity	1 €q	
4 Quality	1 €q	
5 Security and safety management	1 €q	
6 Safety	1 €q	
7 Durability	1 €q	
8 BV8	1 €q	
9 BV9	1 €q	
10 BV10	1 €q	
11 BV11	1 €q	
12 BV12	1 €q	
13 BV13	1 €q	
14 BV14	1 €q	
15 BV15	1 €q	

The risk matrix can be added as a reference (Dutch example below from the Waste water Asset Management Guide by AssetResolutions).

Bedrijfsaanpak	Economie	Veiligheid	Besluitvaardigheid	Parlementaire leiding	Milieu	Compliance	Reputatie	RISICO						Duits graad	0,0003	70
								1	2	3	4	5	6			
Ernstige zone	KPI	€	Ernstgraad	Gebruiksdaag	Waterverval	Verloren vrachtwagen	Ernstgraad	Ernstgraad								
Colofon	>25 M	Meerdere doden	>1000	>10000	>200 m3	Streefcalculator	Strafrechtelijke verantwoordelijkheid bestuurder	Internationale								
Ernstig	2.5M-25M	Eén dode, bijzend ernstig letsel/malicious	1000-10000	>1000	>200 m3	streefcalculator	bestuurder	Nationale								
Behoorlijk	250k-2.5M	Ernstig gewonde	100-1000	>100	>200 m3	Dwangbewel, boete 6e categorie		Regionale								
Matig	25k-250k	Lost time incident	10-100	>10	>20 m3	Aanwijzing, boete 5e categorie		Lokale								
Klein	2.5k-25k	EHBO	1-10	>1	>2k m3	Waarschuwingsorder, zoek bevoegd gezag, boete 3e categorie		Klacht van meerdere klanten samen								
Verwaarloosbaar	<2.5k	Gevaarlijke situatie	<1	>25 m straat	>200 m3	Multitransactie boete 1e categorie		Interne discussie klacht individuele klant								

F	M	H	ZH	O	O	O
E	L	M	H	ZH	O	O
D	V	L	M	H	ZH	O
C	V	V	L	M	H	ZH
B	V	V	V	L	M	H
A	V	V	V	V	L	M

Probleem in matrix	5	0
Score	5	C
Vrijwilde	30,000	70,000
Waarde the asset blad	70,000	
Miet financiële effecten		

4.2 AssetSheet

The tab "AssetSheet" specifies the behavior of the asset. Below is the tab shown.

The screenshot displays the 'AssetSheet' tab, which is divided into several sections:

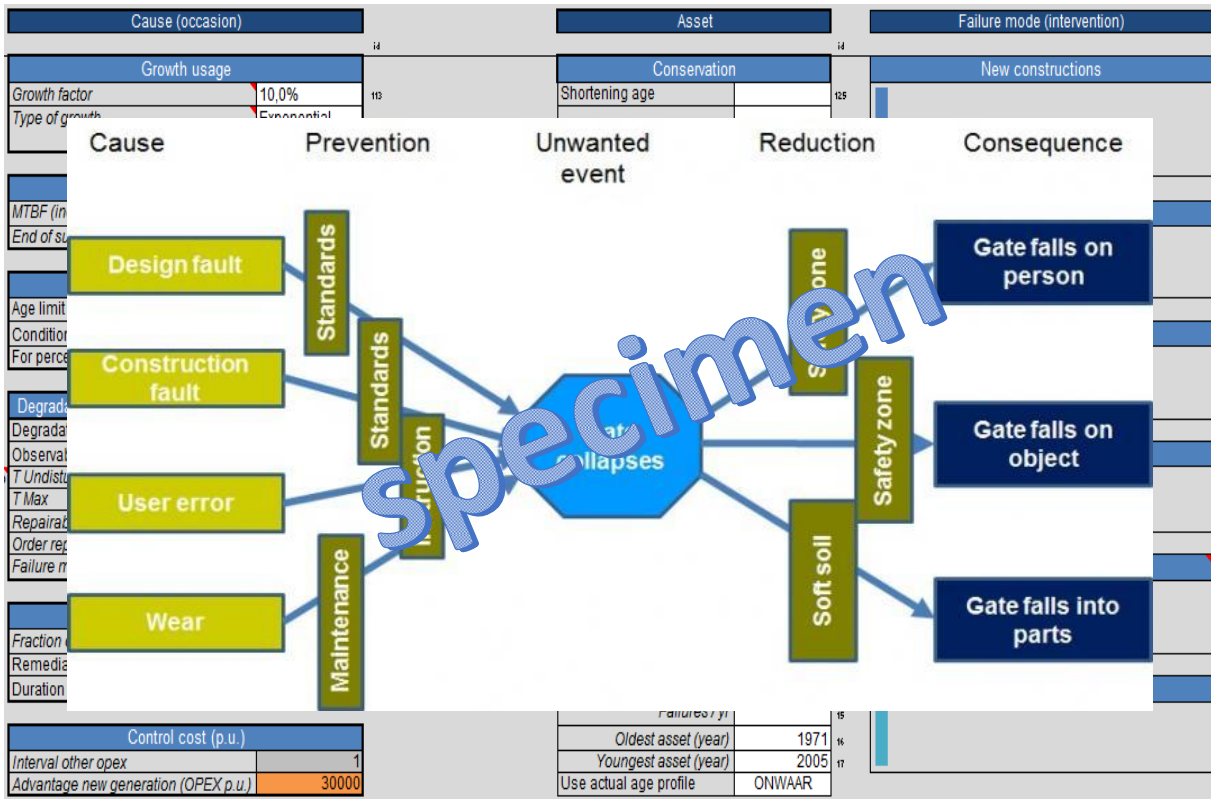
- Causes (accident):** A central diagram showing 'Gate collapses' as the primary event, influenced by causes like 'Design fault', 'Construction fault', and 'User error'. Interventions include 'Standards', 'Safety zone', and 'Safety zone'.
- Consequences (effect):** A table listing various aspects such as 'Personnel injury', 'Property damage', and 'Business interruption', with columns for 'New construction', 'Schedulable', 'Corrective', 'Functional', and 'Repair'. It includes numerical values and a 'KPI/Max. Eq.' column.
- Graphs:** Several line graphs at the bottom showing trends over time for metrics like 'Failure rate', 'Repair rate', and 'Asset value'.

Large blue text overlaid on the image reads: "THIS IS AN EXAMPLE OF A FILLED OUT ASSETSHEET".

The tab consists roughly of 2 modules to fill out data. On the left side (all blue boxes), the BowTie analysis contains the description of asset behavior over time. On the right the specification of the result of that behavior is shown. This will be further described per block. At the bottom of the sheet are some graphs that can be used to check the input.

4.2.1 BowTie model

The asset sheet contains a simplified BowTie model. Six causes and six interventions are distinguished.



Below the BowTie there are two additional blocks.

Failure history	
year	# recorded
2017	
2018	
2019	
2020	
2021	
2022	
2023	
2024	
2025	
2026	

Optimization	
Interest	0%
minimum	32
T optimal	7
maximum	36
Shift chart	10

The table below lists which input fields exist.

ID	Column	Block	Content
1.1	Cause (occasion)	Growth factor	Per block the content is specified
1.2	Cause (occasion)	External failures (per unit)	
1.3	Cause (occasion)	Replacement policy	
1.4	Cause	Degradation of	

ID	Column	Block	Content
	(occasion)	the asset (per characteristic amount)	
2.1	Asset	Conservation	
2.2	Asset	Asset type	
2.3	Asset	Population	
2.4	Asset	Corrective	
3.1	Failure mode/ intervention	New constructions	
3.2	Failure mode/ intervention	Restore TPI	
3.3	Failure mode/ intervention	Planned replacement	
3.4			
3.5			
3.6			
4.1	Asset	Failure history	
4.2	Asset	Optimization	

There are bars in the interventions. These reflect the impact of the intervention on business values. The business values that are affected are listed under the intervention "Functional replacement".

4.2.2 Consequences of failure modes / interventions

On the right side of the AssetSheet you can specify the consequences of the interventions. In principle for each intervention effects on all business values can be specified, although it is expected that planned actions will only require an investment. The consequences of a repair after an internal malfunction are the same as a corrective replacement after an internal malfunction, except for the investment.



The investment is per unit or per meter, the remaining amounts per event.

At the bottom of the page a number of graphs is presented, so it is immediately visible whether the parameters entered are realistic.

In these can be validated:

1. In the top left graph T undisturbed and T maximal (for example, on T undisturbed 95% of population still exists and on T maximal 5%)
2. The optimal moment at the bottom left
3. The middle chart whether the measured number of failures corresponds to the actual number of failures
4. Top right whether the likelihood of repair matches the replacement
5. In the graph to the bottom right whether the cycle length does not increase after T undisturbed.



Between the two graphs on the left, T undisturbed and T max can be changed with "-" or "+" buttons. The step size can be entered left of the buttons.

4.3 Age profile (optional)

If available, a specific age profile can be specified for the asset type. This occurs on the AgeProfile tab. In columns it contains the year of construction plus the numbers for that year of construction.

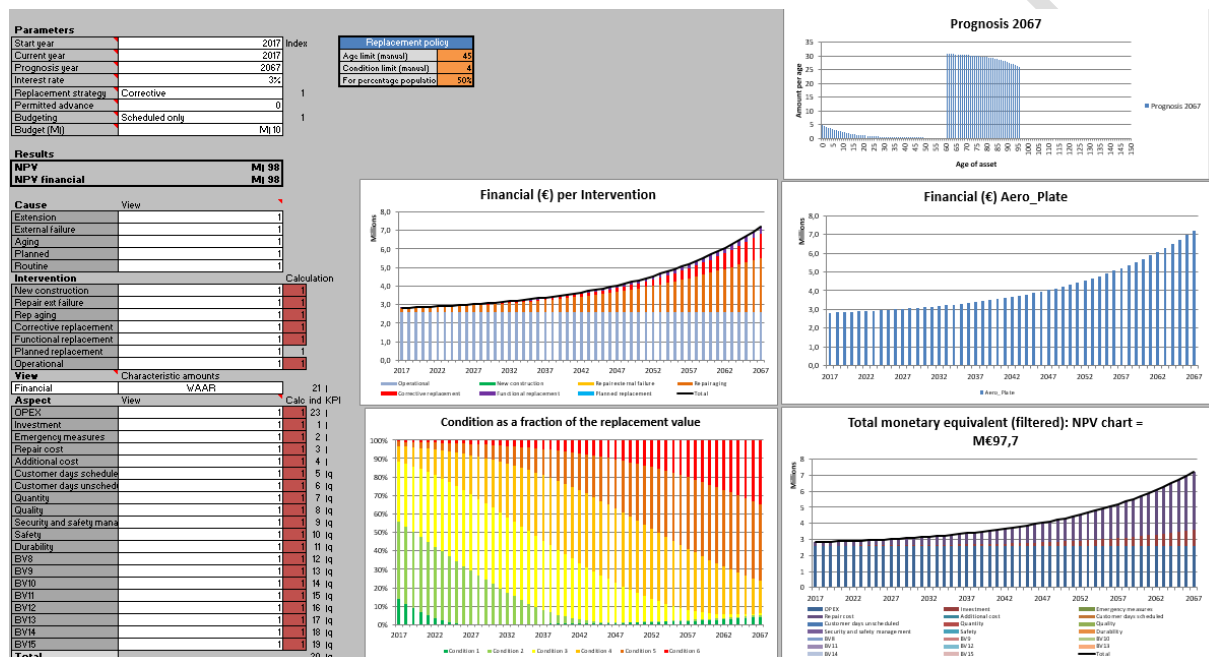


The maximum age is 100 years. At the top, all numbers per year are added to the total population of the type. When the total number differs from the actual number on the AssetSheet tab, the model scales the profile to the actual AssetSheet amount.

On the right the graph with the age profile is shown.

4.4 Dashboard

On the dashboard, the calculation options can be specified, showing the results on the same tab (direct view of the influence of the choices).



The dashboard consists roughly of six blocks. On the top left are the general data that determine the structure of the model. Below are some options for steering the results. The results are shown by the graphs. Above the graphs are the definition of sensitivity analysis (left) and the scenarios (right). On the right side of the graphs are display options for the assets, using five parameters. A brief explanation is given per block.

4.4.1 General parameters

The table below lists the parameters that determine the structure of the model, plus the most important steering variables.

View on dashboard	Example	Explanation
Parameters		Per part a description
Start year	2016	
Current year	2017	
Prognosis year	2020	
Interest rate	1%	
Replacement strategy	Optimal	
Permitted advance	0	
Budgeting	None	

View on dashboard	Example	Explanation
Budget	M 55 €	
Scenario	Base case	

4.4.2 Display options plus results

The Dashboard contains many viewing options. These basically only steer the graphs and not the underlying calculations.

It's too complicated to discuss all the options. Therefore, some important topics are addressed.

1. The display of cause and intervention is linked. If a particular cause is not shown (e.g. aging), the interventions resulting therefrom are not shown. However, there is also a reverse link. If no corrective replacements are shown, then the cause for corrective replacement will not be shown either.
2. Behind the selection of view is an option to display everything in characteristic amounts (basic units). This only has meaning when the population is displayed (visible in graph at the top right) and there are assets that have a characteristic amount other than 1 (e.g. pipe segments or parts of a road). By selecting the display in characteristic amounts, it is visible what the total length is.
3. The business values shown in the monetary equivalent graph are also expressed in a NPV that is shown in the graph title. The actual NPV is shown directly below the generic parameters (both in terms of monetary equivalent ME (= across all business values) and only financially). These values may differ.
4. The view in the Interventions and Assets graphs can be selected by selecting a drop-down list. It also contains a number of aspects that relate exclusively to the asset base. These are Population, Replacement, Book value, Depreciation, Cost and Annual Equivalent Costs (= Annual EQ total). Please note, this is a free interpretation of the terms, they do not necessarily match the accounts of an organization. The Intervention chart remains empty when selecting any of these 5 aspects.
5. The condition in the bottom left conditional graph is based on the replacement value of the assets. The graph shows the distribution between the condition levels.
6. If data is omitted then the set will be set to zero, but it will remain part of the graph. The "Update Charts" button also deletes the empty sequences (or re-added if they have previously been deleted). This is especially relevant for the business values and assets.

4.4.3 Sensitivity analysis

The sensitivity analysis can determine how sensitive the model is for data errors. These are listed in the table below.



Per parameter, the minimum and maximum can be given in relative terms. This thus gives a variation to the normal outcome. The sliders (linked to the Index column) allow a specific variable to be tested. The columns Min, Max and Amp indicate the effect of the minimum and maximum values on the NPV (all others at 100%), with AMPLification indicating the extent to which the changes are amplified. The sign of the Amp indicates the direction: positively, an increasing NPV means a higher value, a negative Amp, a decreasing NPV at a higher value. The maximum age has a negative Amp (longer life means lower cost) but Opex is a positive (higher Opex, higher cost). An amplitude of less than 1 (in absolute terms) indicates that changes are weakened, greater than 1 a strengthening.

The sensitivity analysis (activated by "Sensitivity Analysis" button) works within the specified scenario of cell C11.

4.4.4 Scenario analysis



Rest document empty in demo version