WORKING PAPER

Presentation

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Optimal Asset Allocation Model (OAAM)

Applicable for an Economic Conglomerate

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Summary: OAAM Model

1. General framework

- **The Optimal Asset Allocation Model (OAAM) is a tool for allocating assets and managing economic capital. It is a framework for identifying, measuring and controlling the adequacy of capital to the risks generated by the activities of the organization.**

- **The target tool will help to define the optimal asset structure taking into account regulatory constraints, the global profitability objective and the liability structure.**

- **Helps to dynamically monitor the optimal asset structure in order to make the organization's business model viable and strengthen its financial solidity in the medium and long term.**

- **A management tool to evaluate the impact of the strategic orientations on the organization financial balance.**

1. General Framework

- **The OAAM approach integrates the following elements:**

➲ the specificities of the organization, its activities and its strategic orientations;
➲ compliance with the regulatory requirements to which the organization is subject;
➲ The structure of the liabilities;;

➲ coherence between different risk approaches; ;

➲ the investment horizon.

- **The model allows for:**

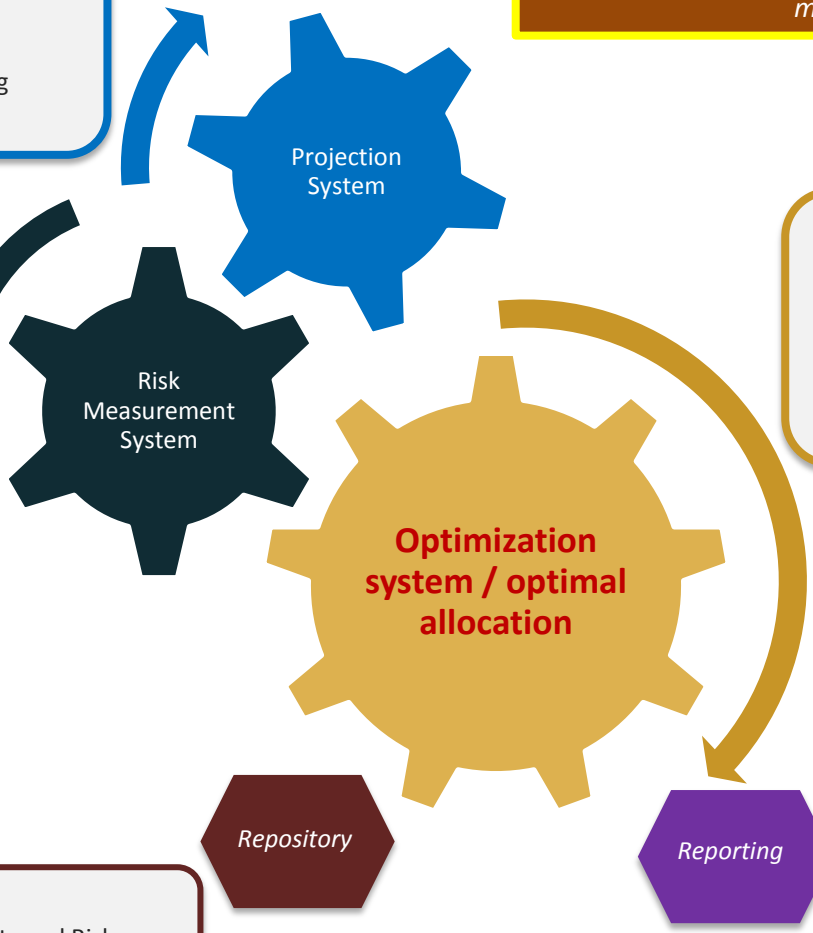
➲ identify the target business size to optimize the expected return on assets taking into account risk constraints and strategic orientations;
➲ to dynamically manage the adequacy of capital to the risks incurred by its different activities;

➲ analyze risks more carefully by covering a wider spectrum of risks borne by the main activities of the organization.

2. Composition of OAAM Model

The OAAM model consists mainly of an optimal allocation system based on a risk measurement system.
A system for projecting capital requirements over the medium term.

- Allows to project the capital requirement on the horizon of analysis taking into account the Medium-Term plans and Strategic orientations according to plausible scenarios.
- Iincludes all projection assumptions and underlying models..



- Will allow to propose the best allocation of the assets taking into account the risk constraints, the objective of profitability, the strategic orientations and the structure of the resources.

- Includes the capital requirement and profitability metrics of the different assets.

- Repository of the assets and Risks

- Overall reporting of relevant indicators calculated by the tool.

3. Assets and Risks classification

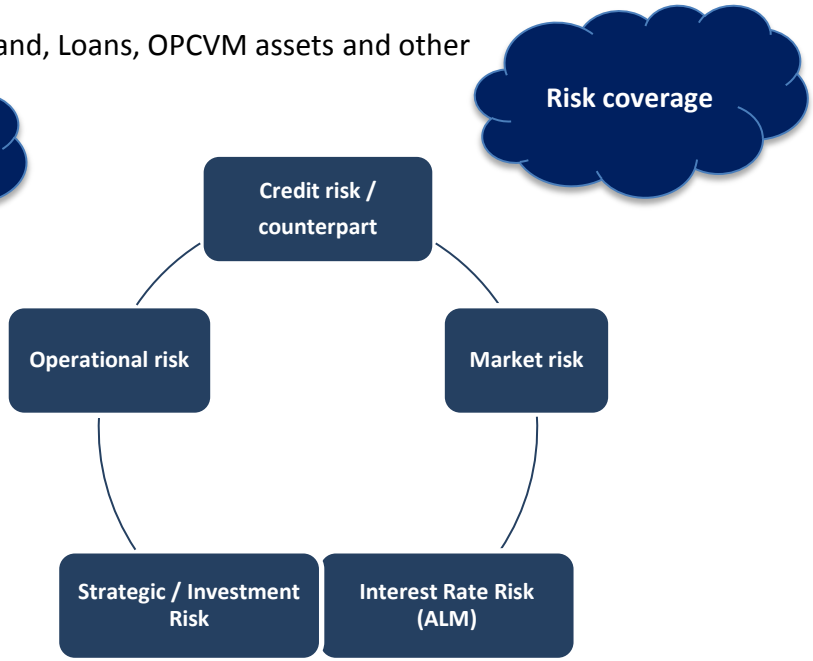
- Depending on the activities of the organization, the assets are classified into homogeneous subgroups, called "Segment". A segment is made up of several entities operating in the same sector of activity.

  - Financial segment « **FIN »;**
  - Infrastructure segment « **ATI**»:
  - Real Estate Segment « **IML** »
  - Tourism segment« **HZT** »
  - Others…

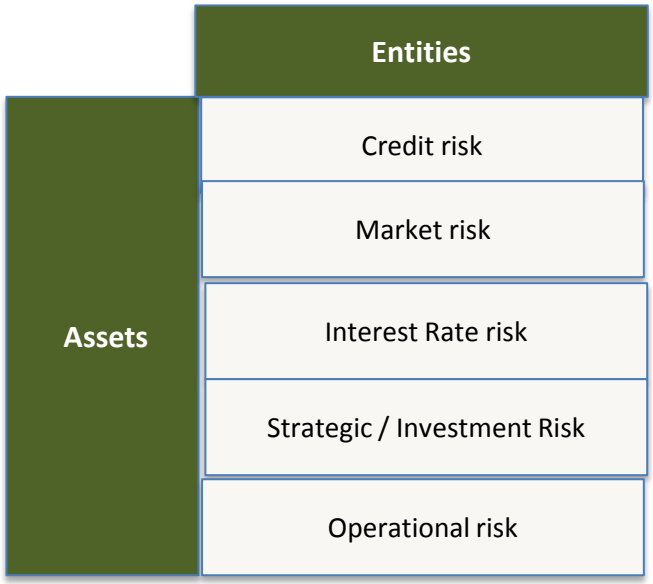
- Asset classification: macro-assets listed covering the bonds; shares; Funds; Land, Loans, OPCVM assets and other assets.

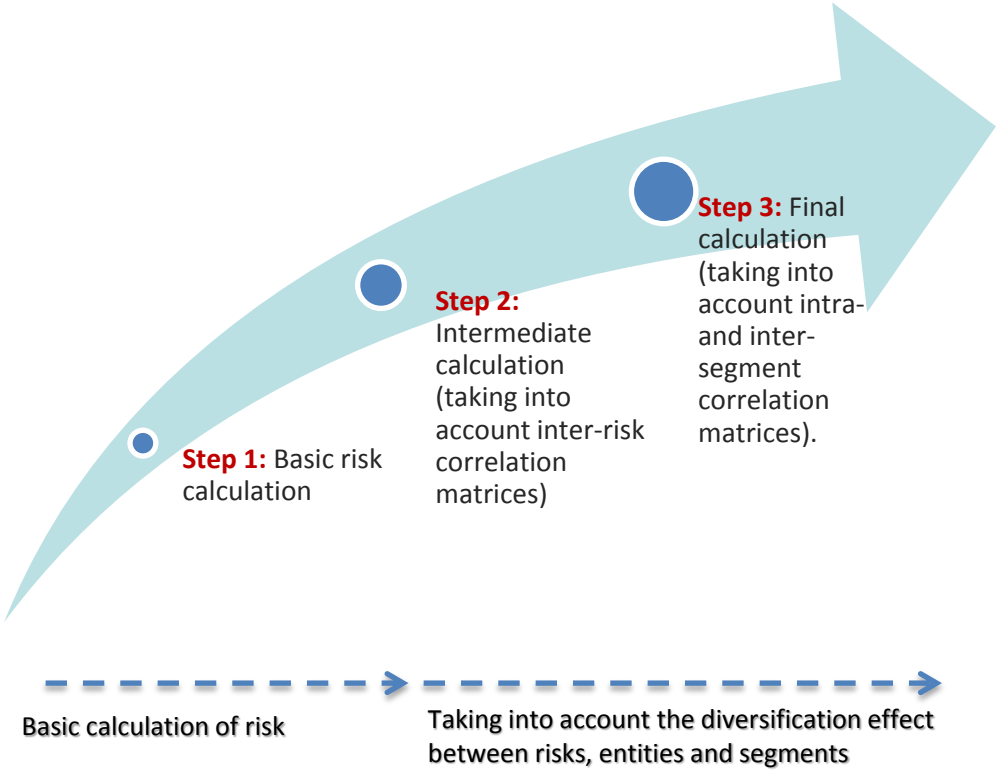
Assets Classification

A1. Short-term treasury bonds
A2. Medium term treasury bonds
A3. Long-term treasury bonds
A4. Short-term bonds
A5. Medium-term bonds
A6. Long-term bonds
A7. Loans
A8. Shares Participation in Credit Institutions (EC)
A9. Shares Partcipation outside EC
A10. Shares (stock market)
A11. OPCVM
A12. Funds
A13. Land
A14. Other Assets



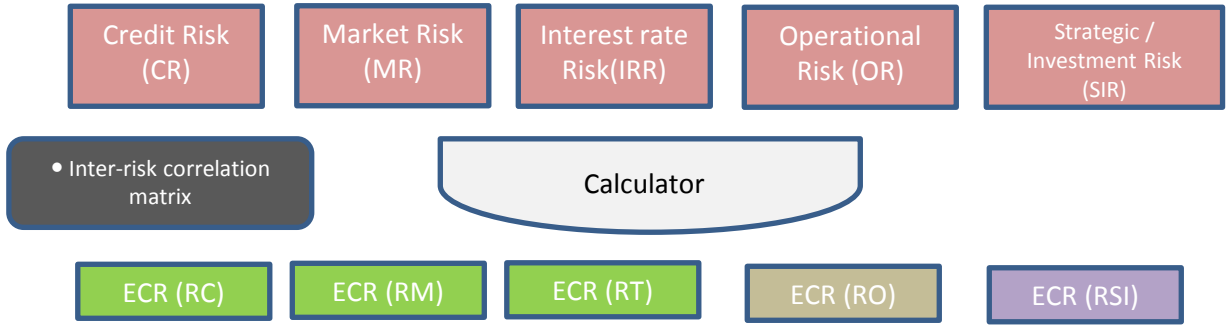
- The system makes it possible to quantify, for each type of risk, by macro-assets and by entities according to the advanced methods , the economic capital requirements in 3 steps..





Step 1: Elementary calculation (macro-asset scale)

Step 2: Intermediate calculation (aggregation at the entity level)



Step 3: Final calculation (organization-wide aggregation)

The model consolidates all the elementary calculations (by macro-assets) and intermediate (by entities) to calculate the economic capital requirement (ECR) of the organization level by considering the intra and inter-segment correlation matrices.

4. Risk Metrics

4.3 Elementary calculation

Elementary calculation (macro-assets scale)

Financial entities

Macro-assets	Credit Risk	Market Risk	Interest rate Risk
A1. Short-term treasury bonds	NA	NA	Gap rate
A2. Medium term treasury bonds	NA	NA	Gap rate
A3. Long-term treasury bonds	NA	NA	Gap rate
A4. Short-term bonds	Interne Fondation approach (LGD 45%)	✓ Placement parametric var Volatility MBI index	Gap rate
A5. Medium-term bonds	Interne Fondation approach (LGD 45%)	✓ Placement parametric var Volatility MBI index	Gap rate
A6. Long-term bonds	Interne Fondation approach (LGD 45%)	✓ Placement parametric var Volatility MBI index	Gap rate
A7. Loans	Interne Fondation approach (LGD 45%)	NA	Gap rate
A8. Shares Participation in Credit Institutions (EC)	Interne Fondation approach (LGD 90%)	NA	NA
A9. Shares Partcipation outside EC	Interne Fondation approach (LGD 90%)	NA	NA
A10. Shares (stock market)	Interne Fondation approach (LGD 90%)	Parametric var Volatility MASI index	Na
A11. OPCVM	Interne Fondation approach selon composition	Parametric var according to composition	Gap rate Applied to bond assets
A12. Funds	Interne Fondation approach (LGD 90%)	NA	NA
A13. Land	NA	NA	NA
A14. Other Assets	NA	NA	NA

Elementary calculation (macro-assets scale)

Interne Fondation approach

$$ECR\ en\ \% = \left(\left[LGD * N\left[\frac{1}{(1-R)^{0.5}} * G(PD) + \left(\frac{R}{1-R}\right)^{0.5} * G(\partial)\right] - PD * LGD\right] * \frac{(1+(M-2.5)*b)}{(1-1.5*b)}\right) * \emptyset$$

$$R = 0.12 * \frac{(1-Exp(-50*PD))}{(1-Exp(-50))} + 0.24 * \left[1 - \frac{(1-Exp(-50*PD))}{(1-Exp(-50))}\right]$$

$$b = (0.11852 - 0.05478 * Ln(PD))^2$$

PD: Average probability of default
LGD: Loss Given Default;
N(x) represents the distribution function of a reduced normal centered law and G (z) its inverse cumulative function.
M: Maturity parameter;
∂: Confidence level
Ø :Adjustment parameter.

Corrected parametric var

$$FPE\ en\ \% = zcf_{\alpha} * \sigma_{indice} * \sqrt{\frac{H}{252}}$$

zcf_{α} : Cornish-Ficher quantile
α : Confidence level
σ_{index}: Volatility by index
H: the average detention time

$$zcf_{\alpha} = z + \frac{1}{6}(z^2-1)S + \frac{1}{24}(z^3-3z)K - \frac{1}{36}(2z^3-5z)S^2$$

Z is the normal quantile
K: Kurtosis
S: Skewness

Gap rate approach

Approach in 4 steps:

1. Establishment of asset / liability stratum by maturity :
ST1: Short term, ST2: medium term and ST3: long term
Assets: by residual maturity of the bond portfolio and loans.
Passive: by flow laws (dynamic / static)

2. Calculation basis by stratum (GAP_{STi}):
Gap between assets and liabilities by stratum;
3. duration calculs (D_{STi}) by stratum of asset;
4. Calculation of the average volatility (adjusted) of the yield curve by maturity ($\sigma_{STi)}$.

Economic Capital Requirement:

$$ECRi\ en\ \% = GAP_{STi} * D_{STi} * \sigma_{STi}$$

i Stratum by maturity

Operational Risk:

Basic indicator (15% of the average NBI (Net banking income) of the last 3 years)

Risk aggregation (with diversification effect)

$ECR_{i,j}$ *economic capital requirement for risk i relating to the entity j.*

Let $ECR_{.,j} = \begin{pmatrix} ECR_{1,j} \\ ECR_{i,j} \\ ECR_{5,j} \end{pmatrix}$ vector of elementary economic capital requirement for the entity j *(j=1,…, m).*

$Aggregate\ economic\ capital\ requirement\ for\ the\ entity\ j:\ ECR_j = \sqrt{ECR'_{.,j} * W_{IR} * ECR_{.,j}}$

$W_{IR}: inter - risk\ correlation\ matrix$

$For\ segment\ s, we\ define\ the\ vector\ of\ economic\ capital\ requirement\ ECR_s = \begin{pmatrix} ECR_1 \\ ECR_k \\ ECR_m \end{pmatrix};$

m being the number of entities in the segment s.

$Aggerate\ economice\ capital\ requirement\ for\ the\ segment\ s:\ ECR_{s(g)} = \sqrt{ECR'_s * W_s * ECR_s};$

$W_s: intra - segment\ correlation\ matrix\ s.$

Let $ECR_g = \begin{pmatrix} ECR_{1(g)} \\ ECR_{2(g} \\ ECR_{3\,(g)} \\ ECR_{4(g)} \end{pmatrix}$ *the vector of aggregate economic capital requirement by segments (4 segments for example).*

The aggregate economic capital requirement for all organization is given by: $ECR_c = \sqrt{ECR'_g * W_{IS} * ECR_g}$

$W_{IS}:\ the\ inter - segment\ correlation\ matrix.$

4. Risk Metrics

4.6 Financial risk parameters

Risk parameters: financial scope

Risk	Parameters						
Credit Risk	Default probabilities by macro assets	Maturity	Adjustment factor	Level of confidence			
Market Risk (Bonds)	Volatility Benchmark index	Kurtosis Benchmark index	*Skewness* Benchmark index	Normal quantile	Cornish-Ficher quantile	Level of confidence	Average time of detention
Market Risk (Stock market shares)	Volatility Benchmark index	Kurtosis Benchmark index	*Skewness Benchmark index*	Normal quantile	Cornish-Ficher quantile	Level of confidence	Average time of detention
Interest rate Risk	Liability Liquidity Strata (ST, MT, LT)	Liabilities duration by liquidity strata	Volatility of the yield curve by maturity				
Strategic and Investment Risk	RWA (Risk-Weighted Assets						
Operational Risk	NBI (Net banking income)						

- **Probability of default** for macro-assets is the weighted average of default probabilities calculated by an internal rating system .
- **level of confidence**: set the most appropriate level according to the particularities of the business model of the organization.
- **Maturity**: 5 years (medium-term investment horizon).
- **Horizon of detention**: average of 10 days for stock market shares and 90 days for bonds.
- **Adjustment factor**: margin of safety to compensate for model errors (retained value 1.05, a safety margin of 5%).
- **Volatility Benchmark index** : $\sigma = \sqrt{\frac{J}{N}\sum_{t=1}^{N}\left(ln\left(\frac{S_t}{S_{t-1}}\right)\right)^2}$; S: daily performance of the index and J is the number of days in the selected year (252 or 365) . For **Volatility of the yield curve by maturity** : average daily standard deviation of maturity (ST, MT, LT) * root (252).

- **Risk parameters:** outside the financial scope

RisK	Parameters			
Advanced method Risk-Weighted Assets (RWA) (*)	Default Probability by Entity	Loss Given Default , LGD (90%)	Level of condidence (99,0%)	Quantile Normal Law

(*) $RWA = \left(z_\alpha * \sqrt{PD * (1 - PD)} - PD\right) * LGD * 12{,}5$

$Economic\ capital\ requirement\ ECR = EAD * RWA * 8\%$

EAD: Exposure at default

PD: **Probability of default of an organization entity** estimated by an appropriate rating model that considers the following factors:

- *Economic, political and legal environment;*
- *Market analysis ;*
- *Characteristics of the activity of the entity;*
- *Quality of Management and shareholders;*
- *Quantitative indicators (financial accounts).*

Risk parameters: inter-risk correlation matrix

The OAAM model uses the following correlation matrix:

- ***Inter-Risk Correlation Matrix W_IR***
- ***Inter-segment correlation matrix W_IS***
- ***Intra-segment correlation matrix $W\_(Intra, s)$***

The Matrix W_IR captures the diversification of assets (macro-assets A1 ... A14) at the level of an entity. His estimate is based on an expert approach that reflects the specificity of the market and the economic and business environment.

W_{IR}	CR	MR	IRR	SIR	OR
CR	1	$Cor_{CR,MR}$	$Cor_{CR,IRR}$	$Cor_{CR,SIR}$	$Cor_{CR,OR}$
MR		1	$Cor_{MR,IRR}$	$Cor_{MR,SIR}$	$Cor_{MR,OR}$
IRR			1	$Cor_{IRR,SIR}$	$Cor_{IRR,OR}$
SIR				1	$Cor_{SIR,OR}$
OR					1

We define a grid for assessing the levels of inter-risk correlations:

Low: 0.2 - 0.3
Average: 0.5
More than average: 0.6
Strong: 0.7
Very strong: 1

$\boldsymbol{Cor_{CR,MR}}$: The credit risk propagates quickly and generates market risk. An transmitter that declares itself in a difficult situation (pre-default) sees the price of its financial asset impacted negatively.

$\boldsymbol{Cor_{CR,IRR}}$: Correlation between credit risk and interest rate risk is low. The interest rate risk depends primarily on the institution's financial backing policy, duration and volatility of the yield curve. Restricted credit risk (not general across the economy) has only a small impact on the yield curve in the primary and secondary markets.

$\boldsymbol{Cor_{MR,IRR}}$: the same for the correlation between market risk and interest rate risk.

Risk parameters: inter-segment correlation matrix

- ***Inter-Risk Correlation Matrix W_IR***
- ***Inter-segment correlation matrix W_IS***
- ***Intra-segment correlation matrix $W\_(Intra, s)$***

W_{IS}	Seg FIN	Seg ATI	Seg IML	Seg HZT
Seg FIN	1	$Cor_{FIN,ATI}$	$Cor_{FIN,IML}$	$Cor_{FIN,HZT}$
Seg ATI		1	$Cor_{ATI,IML}$	$Cor_{ATI,HZT}$
Seg IML			1	$Cor_{IML,HZT}$
Seg HZT				1

$\boldsymbol{Cor_{ATI,HZT}}$: correlation between the two Tourism and Infrastructure sectors. While infrastructure development plays an important role in boosting the tourism activity of a resort / region, it is not a determining factor.

$\boldsymbol{Cor_{IML,HZT}}$: statistics show that the correlation between the two tourism and real estate sectors is weak (in Morocco).

The approach adopted for estimating sectorial correlations combines a statistical approach with economic analysis. Over a period of 10 years, indicators of sectorial activities are observed.

$\boldsymbol{Cor_{FIN,ATI}}$: correlation between the financial sector and the infrastructure sector. The contribution of the financial (banking) sector to financing ATI sector is limited in developing countries. Which gives a low or average correlation.

$\boldsymbol{Cor_{FIN,HZT}}$: same thing for the correlation between the financial sector and the tourism sector.

$\boldsymbol{Cor_{FIN,IML}}$: Correlation between the financial sector and the real estate sector. the banking sector generally contributes significantly to financing the real estate sector (developers and acquirers).

$\boldsymbol{Cor_{ATI,IML}}$: the two sectors real estate and infrastructure sector are strongly linked.

- **Risk parameters:** intra-segment correlation matrix

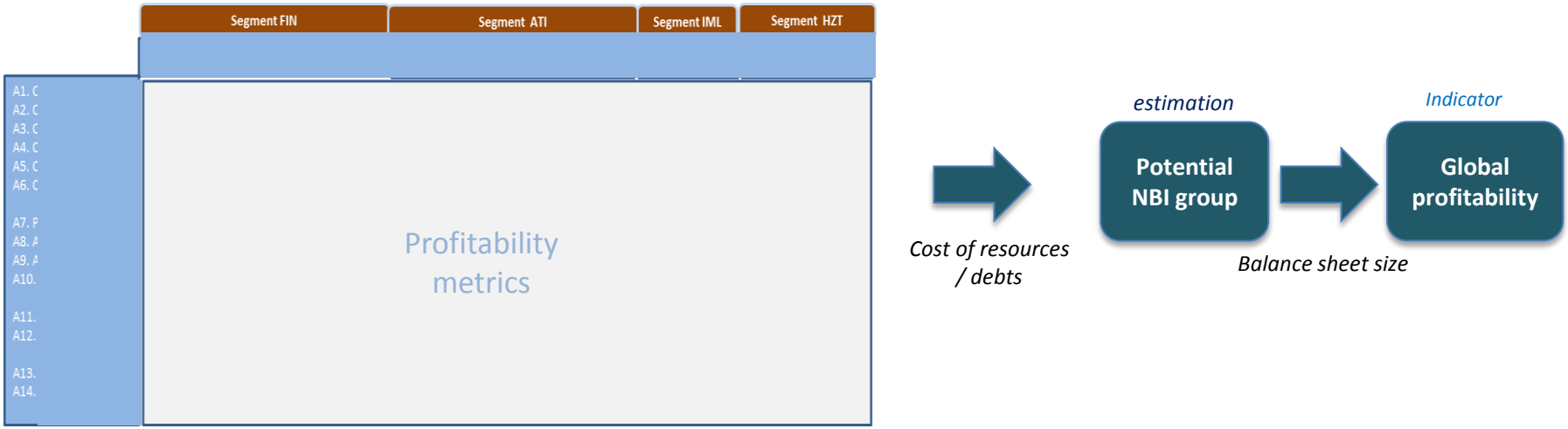
- ***Inter-Risk Correlation Matrix W_IR***
- ***Inter-segment correlation matrix W_IS***
- ***Intra-segment correlation matrix $W\_(Intra, s)$***

Taking into account intra-segment correlation matrix captures the interdependency 'in terms of business' between entities in the same segment. The strong dependence between the entities will result in the acceleration of the transmission of shocks from one entity to the other and thus contributes to weakening the parent company. A compromise must be found between intra-group synergies and the strong dependence between entities across the organization.

For all entities in the organization, it is assumed that the minimum value of the mutual correlation is 0.5. It will be called **organic correlation**, mainly due to belonging to the same group.

The correlation between the parent company and the other entities in the group is naturally very strong (1).

★ Profitability calculations by macro-assets and by entities should be prepared outside the model, in consultation with the entities concerned and the structures in charge of strategy and finance at the parent company level.
★ The profitability metrics should be adapted to the activities of the entities by distinguishing between the operational activities and the non-operational activities taking into account the investment horizon.



★ The model estimates, taking into account calculated returns and resource costs (deposits and debts), the group's potential NBI .
★ An overall profitability indicator is thus estimated based on group net banking income and the size of the consolidated balance sheet..

5. Profitability metrics

5.2 Financial assets

Returns / macro-assets (financial segment)

Returns (*)	Seg FIN
A1. Short-term treasury bonds	Weighted average return of primary rates of short maturities 13W, 26W and 52W
A2. Medium term treasury bonds	Weighted average return of primary rates of maturities 2 years and 5 years
A3. Long-term treasury bonds	Weighted average return on primary rates of long maturities 10, 15 and 20 years
A4. Short-term bonds	Weighted average return of short-term maturities 13W, 26W and 52W + spread
A5. Medium-term bonds	Weighted average return of secondary rates of maturities 2 years and 5 years + spread
A6. Long-term bonds	Weighted average return of secondary long-term maturities 10, 15 and 20 years + spread
A7. Loans	Weighted average of interest rates applied to loans
A8. Shares Participation in Credit Institutions (EC)	Profitability quasi-ROA (Net banking income / total balance sheet) weighted average of the participations in the credit institutions constituting the macro asset A8
A9. Shares Partcipation outside EC	Profitability quasi-ROA (current result / balance sheet total) weighted average of the participations in the companies constituting the macro asset A9
A10. Shares (stock market)	Weighted average return of stock prices of securities constituting macro-asset A10.
A11. OPCVM	Weighted average return of funds constituting the macro-asset A11.
A12. Funds	Profitability quasi-ROA (current result / balance sheet total) weighted average of the different funds constituting the macro asset A12
A13. Land	Land is not intended, in principle, for speculation. Its profitability is supposed to be null.
A14. Other Assets	Return on other assets not listed in macro-assets A1 to A13

- **Returns / macro-assets** (Segments outside the financial scope)

	NOE	Transition phase	OE
Indicators of profitability to be observed (*)	Internal rate of return	Internal rate of return Current result / Total balance sheet on income-generating activities	Quasi-ROA (Current result / Total balance sheet)

OE: Operational entities; NOE: Non Operational Entities.

(*) For all assets except land asset.

- Cost of resources:

Cost of Debt (Debt Service: Interest + Principal) and Deposit Remuneration Reported to Total Balance Sheet. Deposit remuneration only concerns financial / banking entities.

Calculation of the global profitability indicator (GPI):

$$IAb_j = \sum_{i=1}^{14} (R_{i,j} + cj) * k_j * A_{i,j}$$

IAb_j: *gross activity indicator of entity j (net banking income or current result according to the nature of the entity's activity*

$R_{i,j}$: Return of the macro-asset i relative to the entity j;

k_j: Quote share of the parent company in the capital of the entity j.

$A_{i,j}$: Accounting value of the asset Ai relating to the entity j.

Cj: adjustment spread.

$$IAn_j = IAb_j - CR\text{j}$$

IAn_j: *net activity indicator adjusted for resource costs* (CR)

Lets $PNB(r)_j$ and $RC(r)_j$ the NBI or the current result achieved and observed for the 3 years of observation (N, N-1 and N-2).

The adjustment spread Cj serves to correct the difference between the activity indicator calculated and the NBI or current result observed during the 3 years of observation. Its adjustment makes it possible to refine the calculation of the projected profitability by entities.

$$IPNB\ group = \sum_{j=1}^{f} IAn_j$$

IPNB group is the NBI indicator group and "f" is the number of entities constituting the group.

Global profitability indicator :

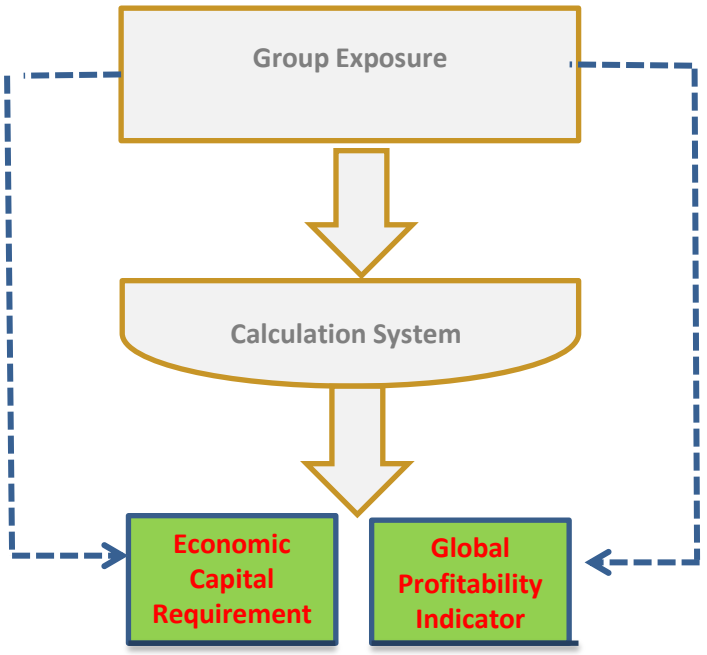
$$GPI\ en\ \% = \frac{IPNB\ group}{total\ consolidated\ balance\ sheet}$$

GPI should be strictly positive to ensure the viability of the group's business model.

↙ **Group exposure:** refers to all the group's financial and non-financial assets listed according to the OAAM model classification and which covers the scope of entities selected at a given date.

↙ From a given exposure, the calculation system displays as final results the two indicators: Economic Capital Requirement (ECR) and Global Profitability Indicator (GPI).

↙ The calculation system displays a number of intermediate parameters:
Economic Capital Requirement with/ without diversification effect and returns with aggregation by instruments, entities and segments.



A group exposure at a given date is characterized by a Economic Capital Requirement (ECR) and a Global profitability indicator (GPI).

6. Calculation System

6.2 Need for data (not exhaustive)

- Portfolios by entities, according to the classification of assets, in accounting values, markets values and provisions; detailed by counterparty;
- Quality of assets by entities;
- Volatility and other parameters of the equity and bond markets (characteristics of the distribution laws of the benchmark index);
- Volatility of the yield curve by maturity;
- Composition of OPCVM portfolios;
- Stratification of liability resources by maturity for financial / banking entities;
- Ventilation of loans by maturity;
- Durations by liability stratum for financial / banking entities;
- RWA assets of non-financial entities;

...

- Inter-risk correlation matrix;
- Intra-segment correlation matrix;
- Inter-segment correlation matrix;…

- Profitability by assets and by entities;
- Cost of resources / cost of debt by entity.
- Prudential and accounting capital;
- Dividends paid to the parent company over the last 3 years.
- NBI or current result over the previous year.
- Capital Quote shares the parent company in the OAAM perimeter entities.

...

7. Assets allocation

7.1 objectives

Taking into account the following elements:
- the risks incurred by the organization and its financial and non-financial entities;
- the performance and profitability of the parent company and its entities in the medium term;
- the wealth of the parent company materialized by its capital;
- and growth prospects for the economic and business environment;

👉 *What is the optimal business size (balance sheet size) of each entity to ensure the viability of the group's business model?*
- What is the best allocation of capital between the parent company and its entities?
- How to decline the recommendations of the OAAM model in recovery action plans at the level of each entity?

OAAM model focuses on macro-asset allocation at the group level. It recommends an overall adjustment of the balance sheet size of the entities and the parent company. The implementation of these recommendations into action plans should be developed with the participation and involvement of the entities taking into account the strategic orientations

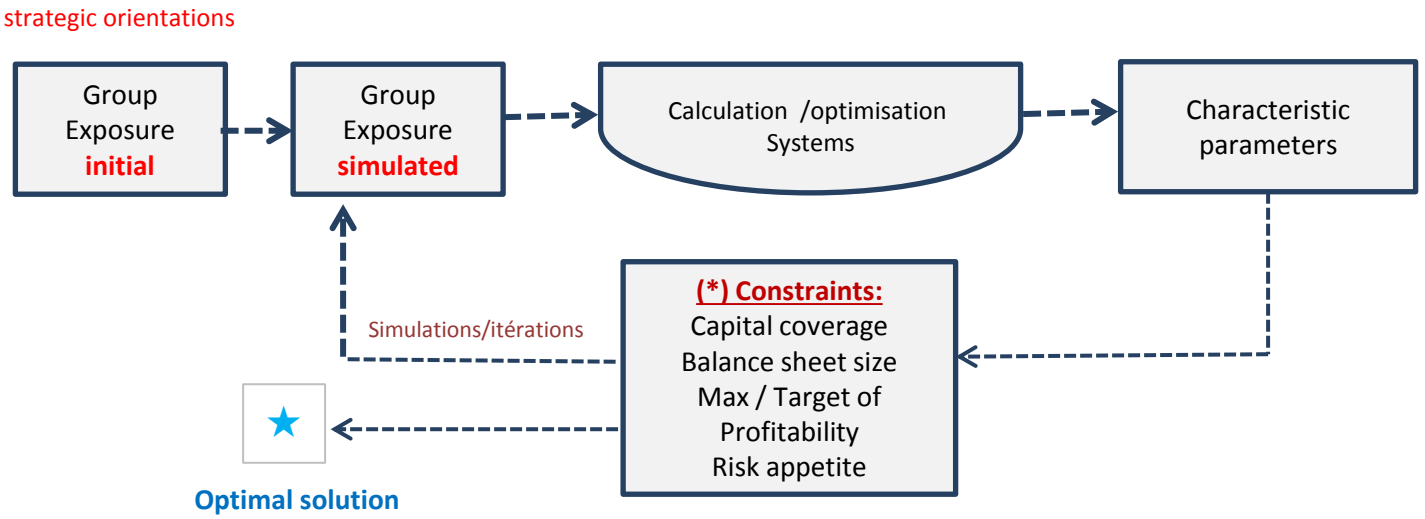
The parent company is expected to be able to absorb all the structural changes at the entity level. The parent company is the core ensuring the financial stability of the entire organization.

7. Assets allocation

7.2 General approach

- The optimization approach consists of developing a system for simulating group exposures according to the strategic orientations, calculating the characteristic parameters, in particular the economic capital requirement and the global profitability indicator by simulated scenario, and seeking an optimal solution that respects the following allocation constraints (*):

 - risk coverage by capital;
- the profitability target to make the organization's business model viable,
- respect for the risk appetite displayed;
- the size of the consolidated balance sheet assumed to be fixed for a given date, reflecting the capacity of the parent company to absorb adjustments operating.



7. Assets allocation

7.3 Optimization approach

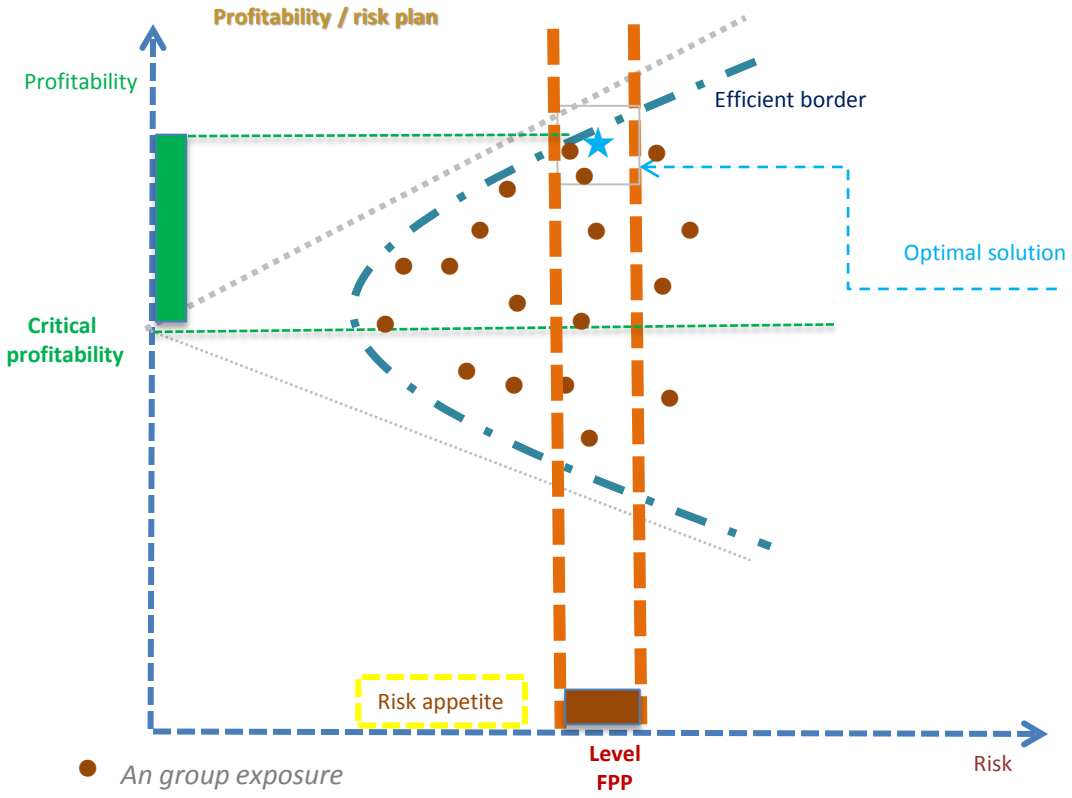
- The optimal allocation system makes it possible to generate a large number of group portfolios according to the strategic orientations. Each group portfolio is characterized by two risk and profitability indicators to project in the profitability / risk plan.

- **Critical profitability** is the level of global profitability below which the group's business model is no longer viable.

- The optimal solution should ensure a level of profitability well above the critical level of profitability.

- The **risk appetite** can be materialized by a risk level higher than the prudential level, which the organization can accept to improve its global performance or achieve a strategic objective. It can be defined as a corridor centered around the Prudential Capital (FPP).

- **The optimal solution** is a group exposure, an optimal allocation of assets reflecting the optimal size of the entities in terms of activities including the parent company, to achieve a level of performance to ensure the viability of the group's business model while respecting the different constraints and the strategic orientations.

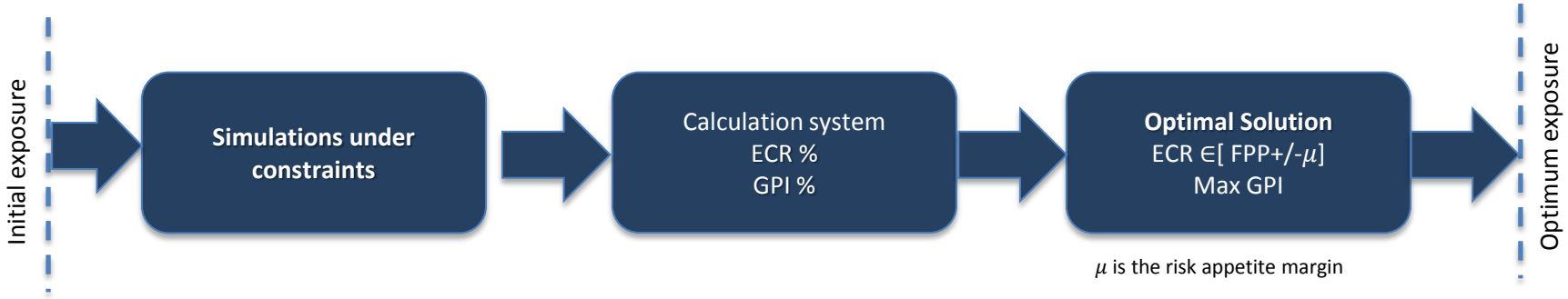


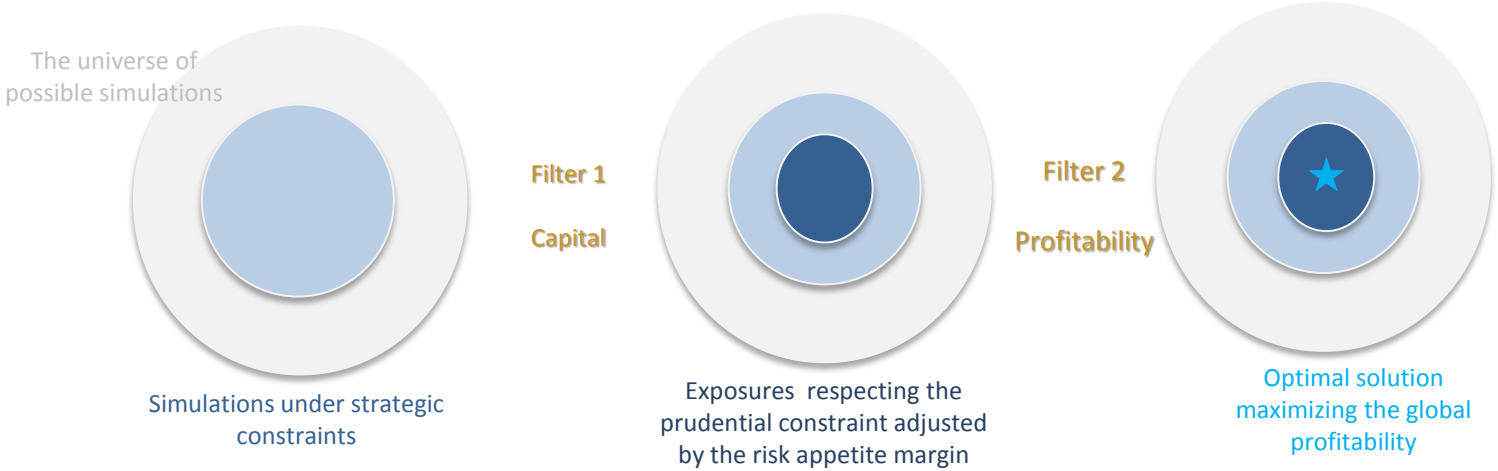
7. Assets allocation

7.3 Optimization approach

Implementing the optimization approach involves three steps:

(1) Simulation of group exposures under strategic constraints;
(2) Research exposures respecting the prudential constraint;
(3) Search for the optimal solution maximizing the global profitability.

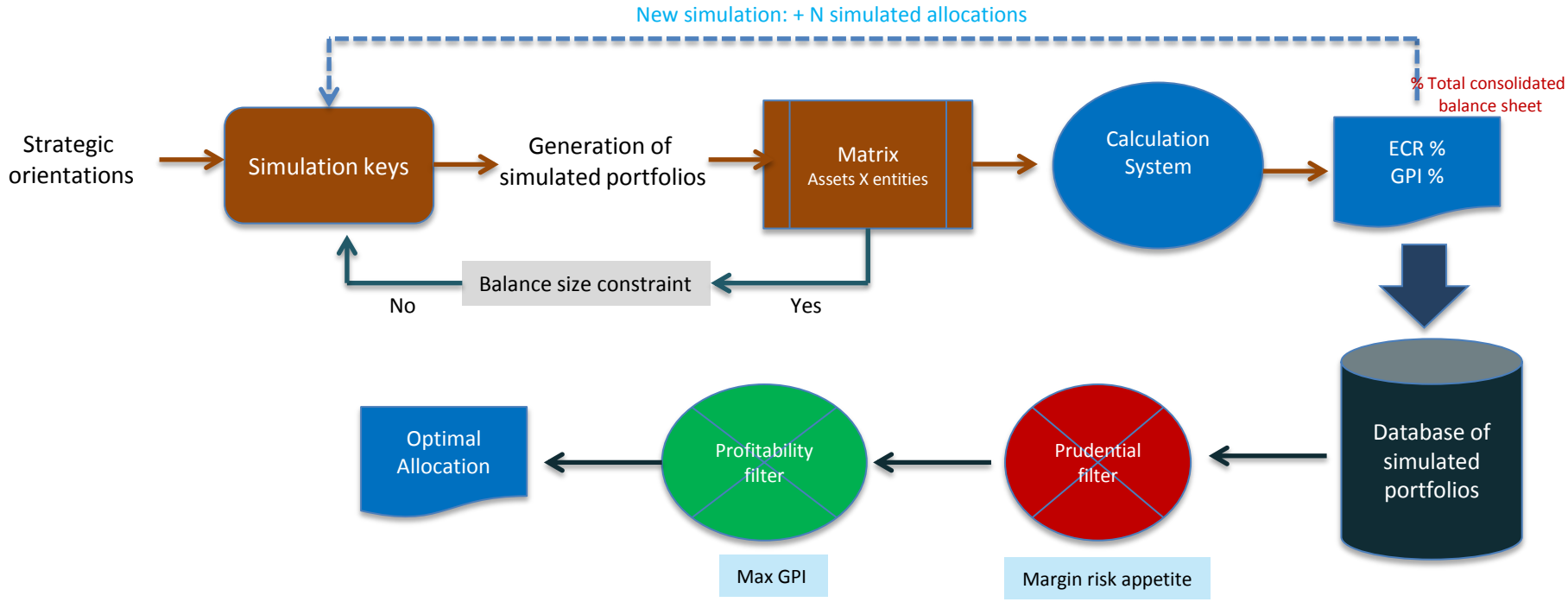




7. Assets allocation

7.4 Implementation

- The strategic orientations are translated into simulation keys to simulate N possible group allocations (N is sufficiently high). At each simulation, the system checks the balance sheet size constraint and readjusts the simulation keys as needed. The group allocation thus simulated is injected into Calculation System, which calculates the economic capital requirement (ECR) and the global profitability indicator (GPI) as a% of the total balance sheet.

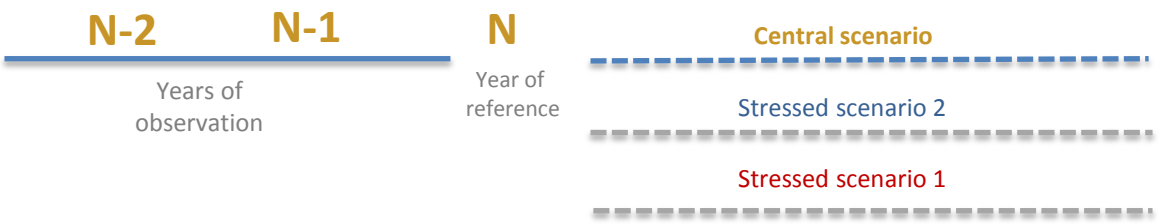


- The results of the simulations are then stored in a database of simulated portfolios (DSP). The DSP is subject to a first prudential filter defined by reference to the previously established risk appetite margin. A second filter, which maximizes the global profitability indicator (IRG), is then applied to the restricted database of portfolios complying with the prudential constraint.

8. Dynamic asset allocation

8.1 Approach

- The **dynamic allocation** is based on a projection system of group allocations according to the MTPs (Medium Term Planning) of the entities, assumptions about the evolution of the resources of the parent company and assumptions about changes in the economic and business environment over a medium-term horizon. . It allows to produce, according to at least three scenarios including a central scenario and two stressed scenarios, the characteristic parameters of the target group allocation. The model uses two years of observation (N-1 and N-2) and one year of estimation (N) to refine the projection of the parameters over the analysis horizon.



- N is the current year of the launch of the allocation exercise (reference year).

- The **static component** of the OAAM Model is applied on a given date and allows, using parameters and data observed during the current year, to produce all the risk and profitability calculations making it possible to evaluate the financial strength and the solvency of the group, parent company and its entities. This component allows for an overall comparative analysis of risk and profitability between all group entities and those operating in the same sector of activity.

8. Dynamic asset allocation

8.2 Projection of group exposures

The projection of group's exposures follows the following approach:

- Calculation of the average weights of the macro-assets compared to the total balance sheet for the parent company and all of its entities according to the observed exposures of the N-2, N-1 and N years. To generate the same exposure tables on the Projection horizon, we use estimated average weights and projections of total assets (activity size) according to macroeconomic scenarios and assumptions from MTPs of the parent company.

- **Central Scenario (PS1)** is defined by projection assumptions that follow the same trend estimated by the MTPs of the entities, macroeconomic assumptions made by the specialized institutions and which condition the evolution of the resources of the parent company and all the parameters of the model.

- **Stressed Scenario 1 (PS2)** defines an evolution of the activities of the parent company and its entities in an environment marked by a deterioration of the financial market.

- **Stressed Scenario 2 (PS3)** is a scenario of global deterioration of the business environment that affects both the financial market and the sectors of the real economy.

Ai: Projected accounting value of Ai assets;
TAssets (p) : Total assets projected by macroeconomic assumptions and the MTPs of the entities and the parent company;
Weight Ai: Weight of assets Ai in the balance sheet observed on average over years N-2, N-1 and N.

$$A_i = TAssets_p * Weight\ A_i$$

8. Dynamic asset allocation

8.3 Projection of parameters

- As an indication, we present assumptions of projection of the parameters of the model according to the three scenarios PS1, PS2 and PS3.

Parameters	Scenario 1 (PS1)	Scenario 2 (PS2)	Scenario 3 (PS3)
Resources of the parent company	Normal evolution (historical trend)	Slow-down	Stagnation
Quality of financial assets	Without degradation	Degradation of the quality of financial assets	Degradation of the quality of all assets
Volatility of the market Actions	Stable	More volatility	More volatility
Volatility of the bond market	Stable	More volatility	More volatility
Volatility of the yield curve	Sable	More volatility	More volatility
Liability duration	Stable	Declining duration on LT maturities	Falling duration on LT and MT maturities
RWA non-financial assets	Stable	Stable	Degradation of the RWAs of the real estate and tourism segments.
Probability of default of group entities	Stable	Degradation of the PDs of the financial segments	Degradation of PDs of all segments
Inter-risk correlation matrix	Stable	Stable	More inter-risk correlation
Inter-segment correlation matrix	Stable	Correlation financial segment-other segments is impacted	Inter-segment correlations are impacted
Intra-segment correlation matrix	Stable	Financial segment is impacted	All matrixs are impacted
Returns on financial assets	Projection MTPs	Declining returns on financial assets	Declining returns on financial assets
Profitability of non-financial assets	Projections MTPs	Stable	Decrease in the profitability of non-financial assets.
Cost of resources / debt	Projection MTPs	Increased resource costs	Increased resource costs

- It consists in defining for the parent company the optimal allocation of capital by business sector, then decline by entities, taking into account the risk constraints, the strategic orientations and the profitability objective.

- Limits are defined by sectorial exposure and by entities that take into account the Prudential capital of the parent company .

- To refine the approach, we use a sectorial nomenclature with the main sectors of the most dynamic economy, reinforced by the financial performance of a chosen benchmark of the best influencers companies.

9. Capital allocation

9.2 Optimization program

- The methodology adopted is based on an optimization program that makes it possible to identify the optimal sectorial allocation and then at the entity level, taking into account the sectorial utility function and the level of risk measured by the economic capital mainly covering the risk of default.

→ optimisation program:

$$\begin{cases} Max\ OF = \sum_{i=1}^{s} SUF_i * X_i \\ S/C \\ ECR_g \leq a.AVC \\ \sum_{i=1}^{s} X_i \leq BB \\ ECR_g \leq a.PRC \end{cases}$$

OF : Objective function
SUF : Sector utility function
Xi : Capital Exposure and Loans
ECRg : Economic Capital Requirement
AVC : Available Capital
PRC : Prudential Capital
BB : Budget base
a : Portion of total capital relating to credit risk

$$FUS = (1 + RES)^{\propto} * NOS^{\beta}$$

Sector utility function SUF: $\mathrm{SUF} = \mathrm{f}(\mathrm{RES}; \mathrm{NOS})$
RES is sector profitability and NOS an indicator
Of strategic orientation.

Sector profitability is the average profitability of companies / firms operating in the sector. This is mainly the return on ROE

ROE. $RES = ROE = \frac{net\ profit}{Capital}$

For a company j operating in the sector i : $RES_{i,j} = ROE_{i,j}$:

The average profitability of sector i is given by: $RES_i = \sum_{j=1}^{n_i} RES_{i,j} * w_{i,j}$

$w_{i,j}$ is the weight of the company i operating in sector i.

n_i Represents the sample size of firms / firms in sector i.

The weight is calculated by reference to the average turnover calculated over the last five years. $w_{i,j} = \frac{CA_{i,j}}{\sum_{j=1}^{n_i} CA_{i,j}}$

→ Solution: $\boldsymbol{COall(i) = \frac{\frac{SUF_i^2}{\sqrt{ECR_i}}}{\sum_{i=1}^{s} \frac{SUF_i^2}{\sqrt{ECR_i}}}}$ is the allocation coefficient. Sector allocation is given

→ by $\boldsymbol{Allocation\ opt\ (sector\ i) = AB * Coall(i)}$

9. Capital allocation

9.3 Sectorial limits

Two capital exposure limits by sector and entity level: A lower limit (Limit), which represents the sectorial exposure to consume a risk budget, is equivalent to the portion dedicated to the credit risk of prudential capital and an upper limit (Lmax), corresponds to the sectorial exposure allowing to consume a risk budget equivalent to the portion dedicated to the credit risk of the accounting available capital.

Calculation of Limit :

$$\boldsymbol{Limit\ (sector\ i) = Coall(i) \times BB_{Limit}}$$

with :$COall(i) = \frac{SUF_i^2/\sqrt{ECR_i}}{\sum_{i=1}^{S} SUF_i^2/\sqrt{ECR_i}}$

BB_{Limit} represents the Limit budget base corresponds to the sectoral exposure to consume the above-mentioned risk budget.

BB_{Limit} is iteratively determined from the initial budget so as to equalize the total capital consumed taking into account the diversification effect and the credit risk portion of prudential capital.

$$\boldsymbol{ECR_g(BB_{Limit}) = a.PRC}$$

a refers to the portion of prudential capital allocated to credit risk.

Calculation of LMax:

$$\boldsymbol{Lmax\ (sector\ i) = Coall(i) \times BB_{Lmax}}$$

BB_{Lmax} is the budget base Lmax corresponds to the sectoral exposure to consume the above-mentioned risk budget.
BB_{Lmax} is iteratively determined from the initial budget in order to equalize the total capital consumed taking into account the diversification effect and the credit risk portion of the available capital.

$$\boldsymbol{ECR_g(BB_{Lmax}) = a.AVC}$$

a refers to the portion of available capital allocated to credit risk.

Optimal Asset Allocation Model (OAAM)

Applicable for an Economic Conglomerate

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